Telephony.
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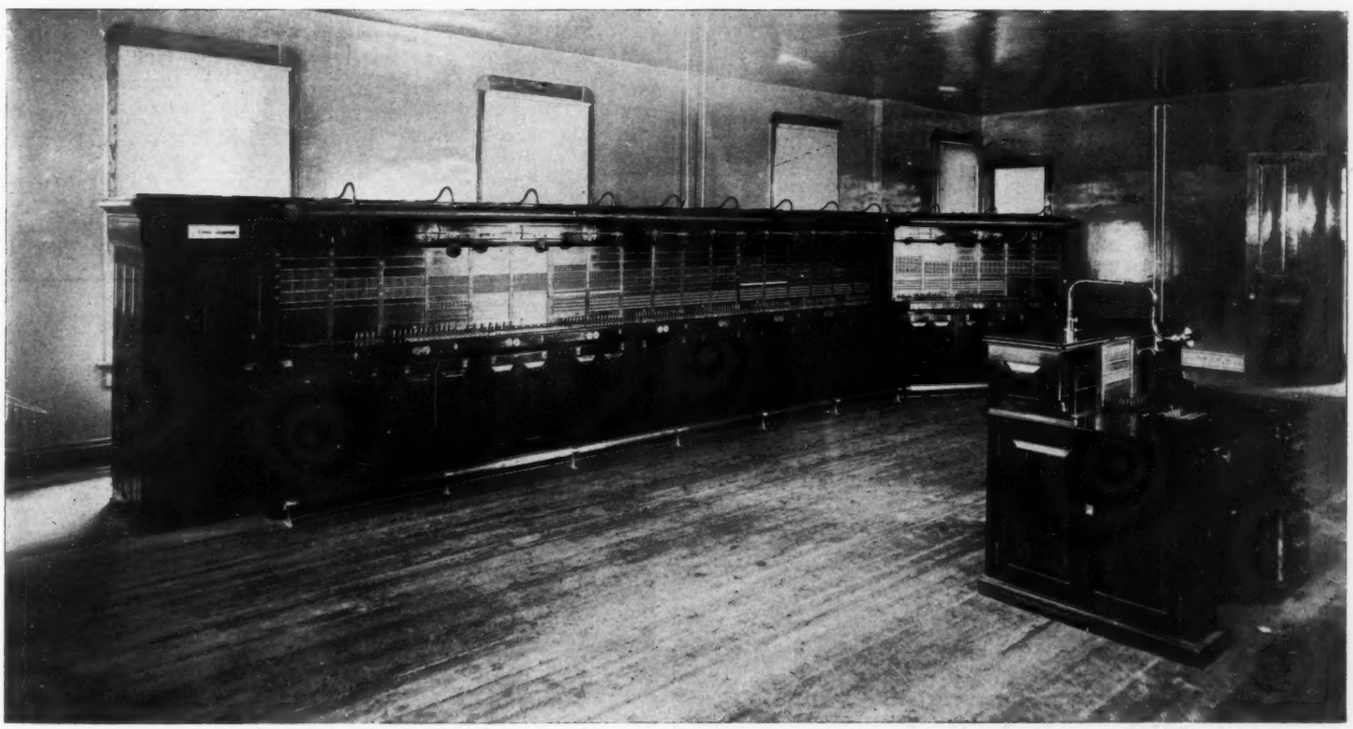
System of the New Telephone Company, Indianapolis

The telephone system of the New Telephone Company, with headquarters at Indianapolis, furnishes another striking example of the progress of Independent telephony in this country.

The switchboard illustrated is installed in one of the new branch exchanges which the company has recently completed in the northern part of the city, located in the center of the residence district. It is the intention of the company to furnish service to the northern half of the city through this exchange. A number of trunk lines run from this exchange to the main exchange in the heart of the city. At the present time about three hundred subscribers are connected up with this board and new ones are being added at the rate of about fifty per day. The general system of distribution is entirely underground in the heart of the city. A large part of the cable is 210 pair made of No. 20 B. & S. copper wire with two wrappings of paper and a sheath of pure lead without tin.



MAIN OPERATING ROOM, NORTH OFFICE, NEW TELEPHONE COMPANY, INDIANAPOLIS.

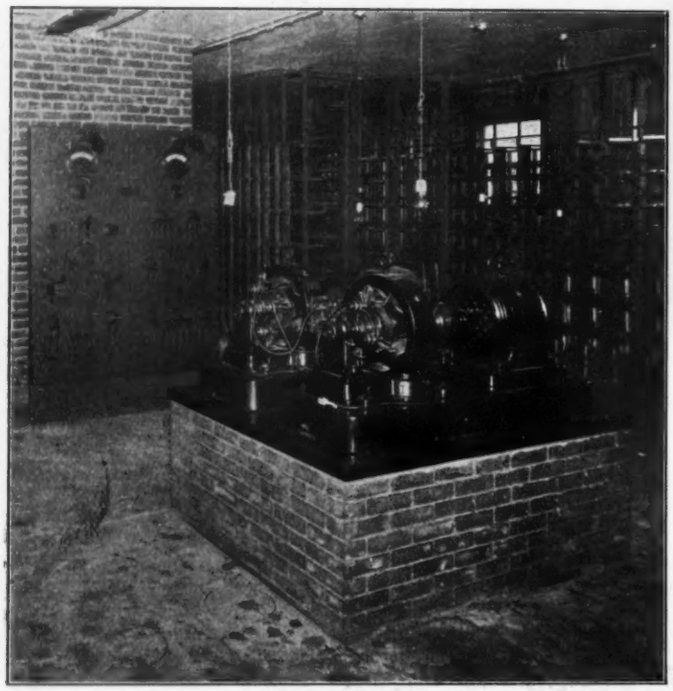
The general style of construction is modern and like many other independent companies the plans of the New Telephone Company have been liberal and broad. The growth, which they have been able to handle easily, has been remarkable. There are three exchanges in the city belonging to this company; the third one called the South office being located in the southern part of the city, and is designed to take care of the subscribers in that part of the city only, trunk lines running to the main exchange. Subscribers' lines in the northern part of the city terminate in the North office and are numbered about 6,000 high, and those of the South office are numbered above 9,000. This has made it necessary to change all the numbers of the subscribers in the northern part of the city and has caused some confusion, but this will be straightened out in a short time and then it will not be necessary to give the name of the exchange, "Main," "North" or "South," with the subscribers' number.

The exchange building was designed by one of the leading architects of Indianapolis and is a modern structure three stories high, built of brick. The building faces south on one of the residence streets. The first floor is occupied by the operators' recreation room, switchboard room and store room.

The third floor is finished as a residence with all modern improvements. In the basement of the building is located

the distributing apparatus, battery room, power board, charging and ringing machines, and wire chief's desk.

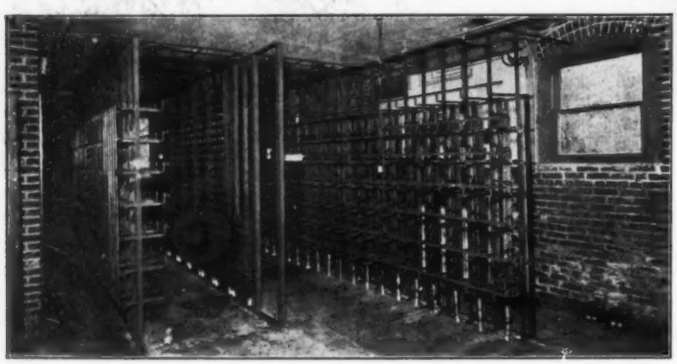
All the underground cable enters the building through a conduit system terminating in the basement. From here the cable is brought up to the main distributing frame after being separated into one hundred pair cables. The storage battery is located in a separate room built in one corner of the basement. A window in one end of this room gives sufficient ventilation.



NORTH OFFICE POWER BOARD AND DISTRIBUTING FRAMES, NEW TELEPHONE CO.

The building is well ventilated, lighted with electricity and heated by the hot water system and has every convenience of an up-to-date telephone exchange. The switchboard has a present equipment of 1,280 lines and an ultimate capacity of 3,000 subscribers' lines. New sections can be added without interfering with the service.

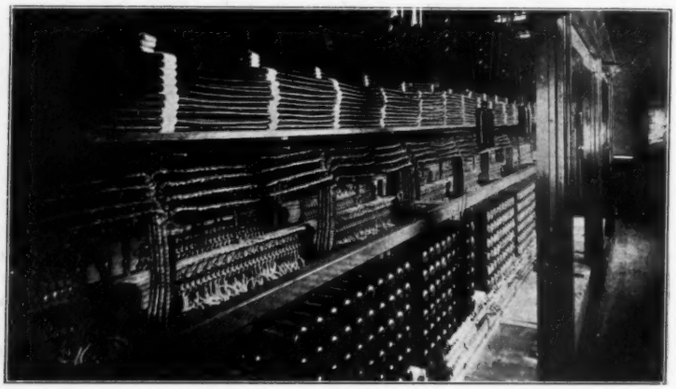
The switchboard is very handsome in appearance and is of solid mahogany and was designed and built by the Kellogg Switchboard & Supply Company of Chicago, who



NORTH OFFICE TELEPHONE SWITCHBOARD (REAR VIEW), NEW TELEPHONE CO.

aim to produce switchboards, telephones and apparatus that will meet the requirements of all kinds of service.

On the right of the illustration representing the terminal and relay racks is that part of the equipment known as the Main distributing frame; it is at this point that the wires are brought from the underground conduits and distributed to their proper position. At the rear of this frame are located the heat coils, which are intended to arrest lightning or any other foreign electricity which might get on to the outside lines and carried to the exchange. Should a foreign current get connected with the wires, the heat coil, which is made to withstand a low voltage, will release a spring, which in time will ground the circuit, thereby pre-



NORTH OFFICE DISTRIBUTING FRAMES AND RELAY RACKS, NEW TELEPHONE CO.

venting the foreign current from reaching the switchboard. This apparatus is also of the Kellogg Company's own manufacture.

There are two special Holtzer-Cabot telephone generators, each directly connected to an alternating current motor; one is connected to a two-phase Westinghouse motor, and the other to a single-phase Wagner motor, each receiving its current from a different source.

The ringing machines are in duplicate and have "busy-

NORTH OFFICE BATTERY ROOM, NEW TELEPHONE CO.

back" and "don't-answer" attachments. There are two sets of batteries with lead lined tanks. The power switchboard is used in connecting and disconnecting the various charging and discharging circuits.

It is stated that arrangements have been concluded between the directorate of the Alexandra Palace and Messrs. Armstrong and Orling, the inventors of the new wireless telephone for experiments in wireless telephony between the Palace grounds and the town of Saunderton, Bucks, where the wireless currents are now being tested in the explosion of bombs before officials of the war office. Tests are also to be conducted from the bottom of the shaft of a coal mine in South Wales and another mine in Yorkshire, the important discovery having been lately made that better results are obtained with the wireless apparatus at a considerable depth below the surface of the ground.

PRACTICAL TELEPHONY

Conducted by P. KERR HIGGINS, A. M. I. E. E.

ARTICLE II.

Telephone systems to-day are divided into three distinct parts: (1) Instruments, (2) Central Office Apparatus, and (3) Lines (including cables), and will be treated in this order.

Instruments.—The first successful attempt to transmit sounds by using electricity was made by Reis, in 1861, who

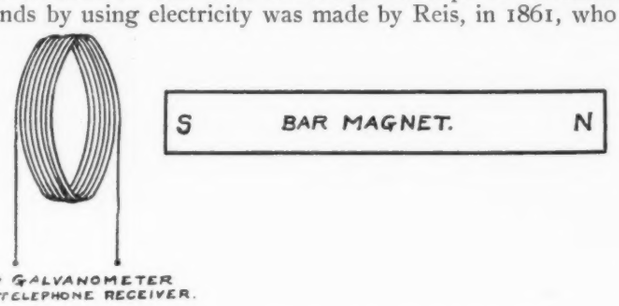


FIG. 3.—PRINCIPLE OF RECEIVER

succeeded in conveying musical tones. This was done by a loose contact in an electric circuit; the voice acting on this varied the resistance. The transmitter consisted of a diaphragm of stretched membrane of taking up these changes, or vibrations, to which was attached an elastic strip of platinum. which, as it vibrated from and against the tip of a platinum wire, performed the making and breaking contact motion in much the same manner as the carbon button in the Blake transmitter. The receiver consisted of an iron wire fixed on a sounding board and surrounded by a coil of wire (insulated), forming part of the circuit. The trouble in this case was poor transmission, hence the failure of the receiver. The poor transmission was due not to the principle, but to the extremely light contact, making the interruptions of the current very abrupt.

PRINCIPLE OF THE RECEIVER.

This is dependent on the transmission of vibrations, which, in turn, are dependent on the principle of electro magnetic induction. In 1831 Faraday discovered that currents could be induced in a closed circuit by moving magnets near it, or by moving the closed circuit across the magnetic field, thus if a coil of wire be connected in series with a delicate galvanometer, or a receiver, and a bar of steel, magnetized, be inserted quickly into the hollow of the helix, or coil, as in Fig. 3, the wires G being connected to a receiver, or galvanometer, a slight click, or deflection, will be heard, or perceived, showing the presence of a momentary current flowing in the circuit. If rapidly put in and out of coil, a current will flow each time in opposite directions. The same result would be had by moving the coil to and from the magnet—the faster this experiment is performed, the stronger will be the induced currents. One coil, in which a current is flowing, inserted into another coil connected in circuit with a galvanometer, will produce similar results. If the coils be brought close to and taken away from each other, or if the battery circuit is interrupted while in or near each other, like results will be had. Thus we perceive that a decrease in the number of lines of force which pass through a circuit produces a direct current, while an increase produces an induced negative current. The telephone receiver is made on this principle, when a current is passed through the coils (Fig. 4) A A, the diaphragm D responds. In talking through a receiver of this kind the speaker talks to the diaphragm D, which vibrates and transmits its every movement to another receiver in the circuit on the principles already explained. This instrument is now used only as a receiver, but when first invented it was common to find many private lines with only a receiver at each end. I have known of lines a mile in length, which gave fair service; clear, but weak. The diaphragm D is placed behind a conical opening in the cap E, and behind the diaphragm is a compound, bi-polar, magnet, running the whole length of the receiver, and on the two poles B B are fixed two small coils of fine insulated wire connected to the binding posts C C. When these alone are used for transmission no battery is needed, as the magnet generates the induced currents, when the diaphragm vibrates toward the magnet more lines of force meet it, and when receding fewer meet it. Its motion, or vibration, therefore changes the lines of force which pass through the hollow of the coil, as already described. When used as a receiver only, the transmitted, induced, or direct currents, pass through the coils, attracting and repelling the diaphragm. This action can be very easily understood by Fig. 5, where D is the diaphragm, A the compound magnets and B the coils wound round the pole pieces—of the magnets. C C is a line connecting the two for an experiment, or a short line, when economy is required. This is the simplest form of telephone known, and for short distances is efficient.

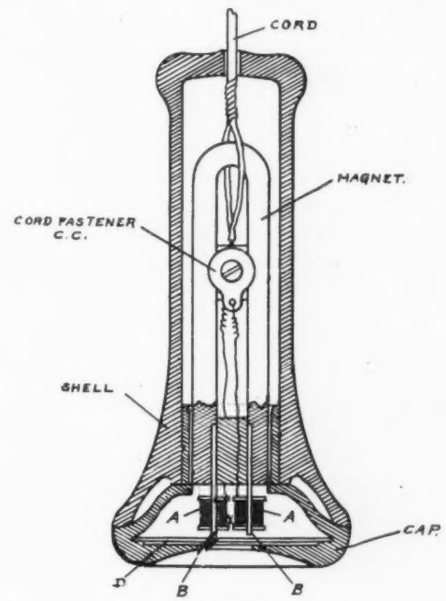


FIG. 4. RECEIVER.

A current increasing the magnetism of the magnet increases the attraction between the core and diaphragm. A current decreasing the magnetism will have an opposite effect, again, inasmuch as the diaphragm in close proximity to the magnet is itself a magnet, by increasing or decreasing its distance from the core, the variation thus caused in the magnetic field will generate corresponding induced currents in the coils surrounding the core, these will pass along the wires c c and in turn produce corresponding variations,

or changes, in the magnetic field of the magnet and diaphragm at the other end. The sine waves can be understood by imagining the diaphragm to have a point of equilibrium, which is a straight line, Dia. 6, the waves above representing the magnet attracted and those below the magnet receding, or the magnetism of the magnet increased and decreased on each side a zero point. It must be understood that the two receivers on such a line do not act exactly

FIG 5 - SHORT LINE USING RECEIVERS ONLY.

alike, as the diaphragm of the receiving instrument will be nearest to the core when the intensity of the induced current is greatest, corresponding to the time the transmitting receiver is vibrating fastest back and forth over the dead line, or point of equilibrium, as already explained. The very slight difference in the wave motion between the receiver and transmitter is not perceived by the human ear. The laws of speech are indispensable to understanding the operation of the telephone. Sound, the basis of speech, is due to vibration in the air molecules. These reach the ear and corresponding vibrations on the tympanum, or ear drum, excites the acoustic nerves and communicates to the brain the sense of hearing. Loudness depends on the intensity of the vibration. The three qualities which characterize the human voice are pitch, loudness and timbre, or sound color. "What is explained in reference to sound, mathematically, is done unconsciously by the ear."

Sound is represented as waves, varying from one side of a straight line to another, as shown in diagram 6, and are termed the simple harmonic, or sine waves, varying according to the pitch, number and intensity of partial tones. The voice can be recognized over the telephone by its timbre, or color. It is therefore necessary that the vowels and consonants retain their acoustic color throughout, then the diminuition in pitch will not affect the distinctness of the transmission, and the voice of the speaker will be easily recognized. This was the trouble with the early telephones,

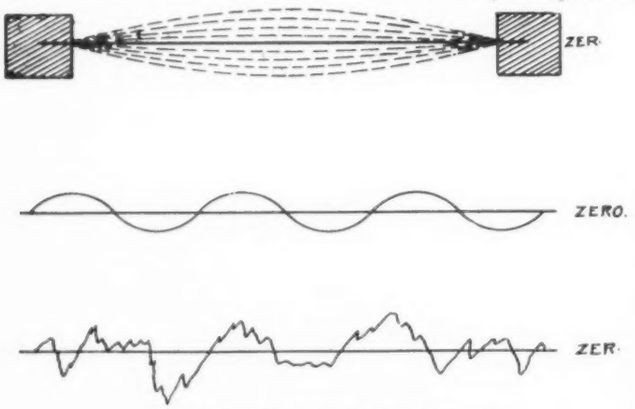


FIG. 6 VIBRATION OF DIAPHRAGM. SHOWING SINE WAVES.

which were capable of transmitting harmonic vibrations, or melody, but could not convey articulate speech. Bell, taking advantage of former experiments, improved on them and produced an instrument capable of retaining the acoustic color of the human voice, so that voices are readily recognizable, which is indispensable in business.

The construction of a good receiver should embrace the following: The diaphragm should be made of ferro-type, soft iron, and be from two to two and a half inches in diameter, varnished on one side to prevent rust. It is not well to use too thin diaphragms, as they are too easily magnetized to the point of saturation, yet they should be very elastic and permit of free vibration; if made too thick the flexibility is destroyed. About ten mils is considered the best thickness for uniform results, and it is important that they be made homogeneous throughout. The damping effect on the diaphragm at the edge should be uniform, hence the rim of the shell should be uniform. The distance between the pole pieces and the diaphragm should be exactly 1-32d of an inch. "The arrangement of the coils and diaphragm best suited to produce distinctness is one where the greatest number of lines of force run through the coil at right angle to the plane of the coil." The coils attached to the ends of the permanent magnets are wound with fine copper insulated wire, the size varying from five to thirty-five mils and the resistance from fifty to one hundred and fifty ohms. In some later forms of the Bell receiver the wire bobbins have been made longer, so as to permit of more turns being used, but, while greater efficiency has been claimed for this style, after many tests I could find no marked difference. Formerly these spools, or bobbins, were made of wood, but now are of metal, are stronger, and do not affect the efficiency.

The Bell receiver, used until recently, had but one pole piece, or magnet. It consisted of four flat strips of steel four and a half inches long and one-eighth inch in thickness; these are clamped, or screwed, to the pole piece, forming one magnet. These were supposed to lift sixteen ounces, but few did it. The wire used on the spool was five mils in diameter and had 1,500 turns, the resistance being about eighty ohms. The shell was originally made of ebonite and remained good for years, but to-day they are made of an imitation, which turns green, or a dirty yellow, in one year (difference in cost of about fifty cents). The coils on the pole piece have soldered to them wires about forty-five mils in diameter, connecting to the binding posts on the end of the shell. The shell is of two parts—the receptacle, for receiving the magnet, etc., and the cover, which is screwed on. Later models are of the bi-polar style, figure 4, and are of two classes—one for common battery and one for local battery, the only difference being in the resistance of the coils. The magnet, however, is horse-shoe shaped, and is supposed to have double the lifting power of the old style. That it is a superior receiver is now admitted by all, although the Bell company was very slow in adopting it, and there are hundreds of thousands of the old, clumsy style still in use.

It seems strange that the bi-polar should be used almost exclusively in Europe and South America and by the new companies in this country, while the older and parent company is only bringing it into use. The adjustment of the new receiver is also an improvement. In the old style the magnet was fastened into the shell by a screw at the end between the binding posts and this regulated the distance between the diaphragm and the magnets. In the new, the shell is tapped and the magnet screwed into this and held in place by a lock pin and is self-regulating, if properly cared for and properly adjusted before using it. The pin lock holds the adjustment under all ordinary conditions, so that any amount of jar or rough handling does not alter it. This is very important, as a receiver is usually roughly handled. The magnet and coils should be held only at the front end of the shell, the remaining part of the magnet being free, thus permitting of contraction and expansion of these parts, caused by changes in temperature. It is important that all parts of the receiver bear proper relation to each other; that the winding has just the proper number of turns to give the best results, working in conjunction with the strength of the permanent magnet; that the diaphragm be of the proper thickness and diameter, so that the sound waves may be accurately produced. In this connection it is well to state that, as in music, so in telephony, clearness and loudness

are antagonistic to each other, and preference must always be given to clearness. A special receiver is made for testing purposes, e. g., for the use of a lineman; the diaphragm is large, about four inches, and of tinned iron, varnished on one side. It is made heavy, because it is used by them as a receiver and transmitter, otherwise the instrument is similar in construction, the only difference being that it is made very strong, so that it will hold together with rough usage, such as must be met with in line work. The cord connecting the receiver is of two strands and usually made up of tinsil wire. This makes the resistance high, but is more serviceable than any other kind of wire, being much more flexible and less easily broken. They are made of several lengths—up to four feet. A short piece of the cord cover is usually braided and left out, which is fastened into the eyelet in the receiver, and also on one of the binding posts of the bell, as a protection to the cord tips, should the receiver fall off the hook, or be accidentally dropped.

CONVENTION INDIANA MUTUAL TELEPHONE ASSOCIATION.

Pursuant to call, the Indiana Mutual Telephone Association met in annual session at the German House, Indianapolis, Tuesday, October 14th, 1902.

The meeting was called to order by President Frazee, who delivered the following address:

"Telephone affairs have run so smoothly, the general development has been so great, and most of us have been kept so busy laboring to keep pace with the increasing demands, that we have had little time or occasion to come together during the year of 1902.

"In Independent telephony, we Hoosiers have much cause for state pride. The ups and downs and knocks and fights incidental to entering a new business are with us largely experiences of the almost forgotten past. Struggles and uncertainties we hear of now occurring in many other states, we experienced, it seems, years ago. Five years ago, what now constitutes a small part of us, met here and put forth our best efforts to induce some reliable company to install a plant in this, our metropolis, thereby knitting our plants together with toll lines, giving us an entrance into our state capital, patching up the weak spots in our poorly developed field, and developing the unclaimed territory. Then, perhaps, many of us passed through a period of anxious doubt; doubt possibly of the good faith and sincerity of the new company, or doubt of their ability to meet the Central Union in this, the largest city in its territory. Who of us at that time even hoped for the success that has followed the efforts of this company? And the influence she has given Independent telephony throughout central Indiana, and to some extent far beyond the borders of the state, for reliability and strength? Now, far be it from me to decry the progress of other states, which are doing nobly under conditions which are much more unfavorable than with us, for in Illinois, the Bell company has her Chicago field; in Michigan, her Detroit; in Ohio, her Cincinnati, but in the Hoosier state the Central Union is getting what Sherman called 'war all over the state.'

"Heretofore we have made maps of our partially developed territory, beginning with a spot here and a spot there. After a time, lines would appear connecting some of these spots together, and the lines and spots have so multiplied that it will be much more practical hereafter to reverse this method and leave blank our developed territory, and have spots or desert marks to represent the undeveloped. With such a map, a spot representing a county seat without an Independent telephone exchange, we would have few spots, and no doubt in the near future a spotless map, of the original map of Indiana, representing the developed telephone territory.

"The small clouds that have occasionally arisen in the Indiana telephone sky have mostly been troubles among ourselves; some company in difficulty with some other company; perhaps some one encroaching on territory on which others have a prior claim. Telephone territory is such that you cannot maintain a claim and not work it. Usually, most of us have had plenty to do at home to supply service to the endless number of people who are clamoring for it. Those who are in the telephone business should develop their own fields rather than encroach upon others, and those who desire to enter the business should find new fields or buy good stock in some of the many prosperous companies that have lists of people waiting for telephone service. Again many of us take on a troubled look because some well meaning farmers on the outer edge of our county are installing an exchange on their own account and running right toward our city exchange. If they can furnish that service better and cheaper than we can, or better, all things considered, they are the ones to do it. If all things considered our service is better than theirs, and it should be made so, theirs will eventually give way to the improved service. We should not care how near our city exchanges the farmers build their often indifferent lines, only let them understand that we cannot build and maintain our city exchanges in a cheap way, and that we will give them connection with our exchanges only upon terms that are fair to us.

"Another subject I desire to introduce for your consideration—one that I fear is getting to be a hobby with me—is that of legislation. It seems to me that it is time that this Association or the Central Union Telephone Company, or the people themselves should know something about where we are legally at in Indiana. Here, where telephone development has been the greatest, the most general, our laws setting forth what we may do and what we may not do, are blank.

"I have had one of the leading attorneys of Connersville prepare the following act, and I urge that at the next session of the legislature a strong effort be made by the Association to have a law of this kind enacted:

> "'An act authorizing and empowering the Board of County Commissioners of the respective counties of the state of Indiana, to grant permission to any person or persons, voluntary associations and companies engaged in a general telephone business, the right to erect and maintain telephone lines upon and over the public highways of the respective counties of the state, and declaring an emergency.
>
> "'Section 1. Be It Enacted by the General Assembly of the State of Indiana, That the Board of County Commissioners of the respective counties of the state of Indiana, are hereby empowered and authorized to grant to any person or persons, or voluntary associations and companies engaged in a general telephone business, the right to construct and maintain telephone lines upon and over the public highways of the respective counties of the state of Indiana.
>
> "'Sec. 2. Whereas an emergency exists for the immediate taking effect of this act, the same shall be enforced from and after its passage.'"

After some discussion by the members of the points brought out in Mr. Frazee's talk, Mr. Weik moved that the chair appoint a committee of three to constitute a legislative committee, of which the chair should be a member, which committee should be empowered to look after the interests of the Independent telephone companies in Indiana before the legislature. This motion was seconded by Mr. Gilmore and was unanimously adopted.

The chair appointed Mr. Gates and Mr. Gilmore to act with himself.

The treasurer read his report, showing the expenditures for the past year to have been $44.20, receipts $2.50, leaving

a balance on hand of $79.07. Upon motion of Mr. Stevenson, seconded by Mr. Dougherty, the treasurer's report was adopted.

The election of officers came before the Convention and the chair appointed a committee of three to nominate officers for the ensuing year. Messrs. Gilmore, Rex and Dougherty were appointed, who reported the following nominations: For president, Rome C. Stevenson; for vice-president, Jesse W. Weik; for secretary and treasurer, Harry B. Gates.

The names of these gentlemen were placed before the convention and resulted in their being unanimously chosen.

Mr. Frazee introduced Mr. Stevenson, who presided during the balance of the meeting.

The chair recognized Mr. Dougherty, who spoke to the association at length relative to the litigation that had been carried on by the National Association, and stated that it was expected of the Independent telephone companies in Indiana, that they raise $2,000.00 as their part of a fund to be raised for the continuance of this litigation; $1,000.00 in cash and the remainder at such time as the demand might be made by the association.

Mr. Rex moved that a committee be appointed in the different parts of the state to look after the collection of this money, which motion was carried, and the chair appointed Messrs. Rex and Sale to solicit among the members present.

The chair introduced Mr. Frazee, who introduced the following resolution:

Whereas, a number of Independent telephone companies in the state of Indiana have granted to certain other Independent companies connections with their exchanges without first entering into an explicit written contract governing such connections; and

Whereas, in many cases such arrangements have led to much confusion and the violation of written contracts heretofore entered into by Independent telephone companies, and has occasioned litigation and encouraged attacks upon the doctrine of the right to Independent telephone companies to control their business by contract;

Therefore, be it resolved, that the Independent Telephone Association of Indiana condemns the practice of granting such connection other than by explicit written contracts in which each company shall have the right to refuse business which shall tend to violate its existing contracts, and be it further

Resolved, that the association recommends that each Independent telephone company in this state shall refuse connection with such companies as have been organized and are operated in cities, towns and communities already supplied with Independent telephone service, and which, after such organization, attack the doctrine of the right to control telephone business by contract.

Upon motion of Mr. Gilmore, seconded by Mr. Gates, this resolution was unanimously adopted.

There being no further business, the meeting adjourned.

DECISIONS AFFECTING TELEPHONY

Conducted by ANDREWS & MURDOCH, Berrien Springs, Michigan.

FAILURE TO FURNISH TOOLS.

In rendering an opinion in an action brought by J. S. L. Orr against The Southern Bell Telephone & Telegraph Company for injuries sustained while in the employ of defendant the Supreme Court of North Carolina rendered an opinion as follows:

"The evidence discloses the fact that one Wood was the superintendent of the defendant in charge of this work; that on the morning the plaintiff was injured he came up town to work on another job, and Mr. Wood told him: 'You can drop off from your work. I want you to go out with Purtle on the long-distance telephone line.' The tools and appliances necessary for such work were in the tool house of the defendant, locked up, and Wood had the key. He unlocked the door, and told the hands to put the tools in the wagon, and plaintiff put some of them in the wagon. He then went downstairs after some tie wire, and while down there 'they' called, 'Come on, we are ready,' and he hurried down, got his 'dinner bucket,' got in the wagon, and off they went to where the work was to be done, a distance of about six miles. There were five of them, and they were to work under Mr. Purtle, and when they got to the place where the work was to be done Purtle put them to work, some to digging up the old poles, and some to digging holes for the new poles. When they got the old poles ready to come down, Purtle said, 'Come on, boys, and take it down.' This they undertook to do, but found they had neither pikes nor 'dead men' to do it with, and they undertook to take them down by hand, and by using shovels in place of pikes. 'Dead men' and pikes are the usual implements used in doing such work, and plaintiff contends that if they had had pikes and 'dead men,' the pole would not have fallen, and he would not have been hurt. The plaintiff contends that Wood had the right to hire and discharge, and though he thought it was dangerous to take down these poles without pikes and 'dead men' he feared that if he did not obey the orders of Purtle he would be discharged by Wood. The defendant undertakes to defend itself against the charge of negligence in not furnishing the necessary tools and appliances upon the ground that such tools and appliances were in the tool house, and that it was the duty of the plaintiff to have gotten them; that he and the other hands were told to go to the tool house and get the tools. This does not seem to us to be a satisfactory answer. Purtle was there, and he was the 'boss,' and it seems to us it would have been rather officious in the plaintiff, who had just been hired that morning for a day's work, to have undertaken to supersede Purtle and boss the job. We do not lay any stress upon the contention that plaintiff was afraid he would be turned off, and lose his job, if he did not obey Purtle. This doctrine has been carried to a very great extent, but it has never been carried to the extent of applying to a hand employed for one day, so far as we are aware, and we do not propose to carry it to that extent in this case. But we do think it was the duty of the defendant to furnish the plaintiff with proper tools and appliances with which to do this dangerous work, and that it was not the duty of the plaintiff to furnish them. There was error in dismissing the action as upon nonsuit."

Orr vs. Southern Bell Telephone & Telegraph Co., et al., 41 S. E. Rep. (N. C.) 880.

The Kansas City *Star* has discovered that the rural telephone has destroyed the old-fashioned style of heroism. The farmer's wife, instead of getting out her red petticoat to flag the speeding train, merely telephones the nearest station and advises the agent of the track obstruction.

DIGEST OF TELEPHONES AND KINDRED PATENTS

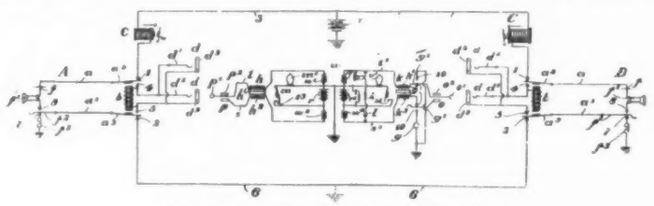
Conducted by EDWARD E. CLEMENT.

SEPTEMBER 16.

12,031—F. W. DUNBAR, TELEPHONE SYSTEM.

This is a reissue of patent No. 689,953, dated Dec. 31, 1901, and assigned to the Kellogg Switchboard and Supply Co. The invention is Mr. Dunbar's two-wire multiple system, with common battery.

In the diagram herewith two subscribers' stations, A and B, are shown. As the connections are the same for each, those of station A only will be referred to. Line wires a and a' pass from the subscriber's station to the central station, where they are connected to the spring contacts a2 and a3, connected to the armatures of the relay b. These spring contacts normally rest on fixed contacts 1 and 2, the former connected through the line relay C and by wire 3



12,031—TELEPHONE SYSTEM.

to the battery r2 and ground; the latter (2) by wire 6 directly to ground.

At the subscriber's station the metallic circuit is normally open at the hook f2, and the side a3 is grounded through the ringer f3, by contact r. Transmitter f and receiver f' are included in the open metallic circuit.

The relay b is ordinarily entirely disconnected from the line wires, being bridged across a circuit d', which extends to the jacks d d d, in multiple. It will be observed that the jacks are also disconnected from the line, and from any ground connection. This feature is of some importance in the test scheme.

The plug cord circuit between each pair of plugs, p and o, is divided by the repeating coil w1 w2 w3 w4, and each side of the repeating coil is divided, a talking battery r being connected between windings w1 w2 on one side, and another battery r' between windings w3 w4 on the other side. In each divided portion of the cord circuit a supervisory relay is connected, having double windings laid on parallel so that the current passing over the metallic circuit will leave the core neutral, while current passing through one winding will magnetize the core. One of these windings is connected in one side of the cord circuit and the other in the opposite side. For telephone currents passing over the metallic circuit the relay is thus neutral and practically non-inductive.

In listening in or testing, the operator's telephone is bridged in the usual manner, while for ringing the operator's generator is also bridged, having one side grounded, as the ringers are all grounded.

In operation, if a subscriber calls by taking down his receiver, line relay C receives current from battery r2 over circuit 3, a, a', and 6. When the operator plugs in, in answer to the call, battery r is connected across the terminals d' and d2 of the jack employed, and relay b receives current therefrom, drawing up its armatures and removing the springs a2 a3 from the contacts 1-2 (thus cutting off the line relay and signalling battery), and causing these springs to make contact with the contacts 4-5, of the jacks. The line is thus connected to the jacks, leaving the relay b bridged as long as the connection continues.

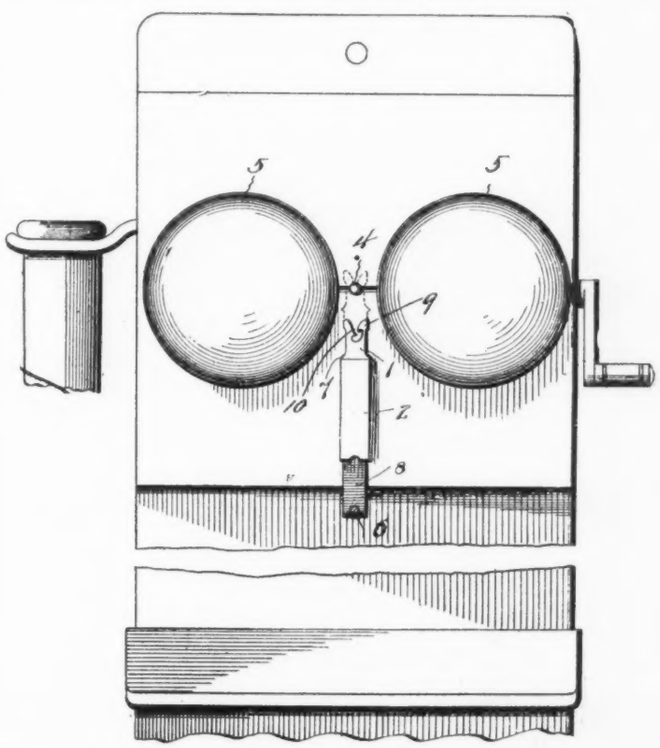
In calling, the plug is inserted and the relay b acts to connect the called line to the jack, and so to the cord, as before, but whereas in the case of the calling line the subscriber's ground was removed when his hook went up and his supervisory relay therefore remained neutral, in the case of a called line the hook is still down, the ground still on, and the supervisory relay k receives current only through one winding, k2, by the path r', s', 5, a3, f2 and f3. The lamp v' thus lights and remains lighted until the subscriber responds.

In ringing out, the generator rings over the grounded side of the line, but it is bridged across the cord in order that the relay b may continue to be energized and thus hold the line on the jacks.

The test is of course by applying the tip of a plug to the ring of a jack, the latter having normally no potential difference from the earth, being disconnected. If a line is in use, however, the potential of the jack ring will be raised, and a characteristic click gives the test.

709,327—Z. E. JACKSON, TELEPHONE CALL ANNUNCIATOR.

This is a convenient form of indicating drop that may be attached to the clapper of any ordinary ringer to indicate when a call has been made during the absence or with-



709,327. TELEPHONE CALL ANNUNCIATOR.

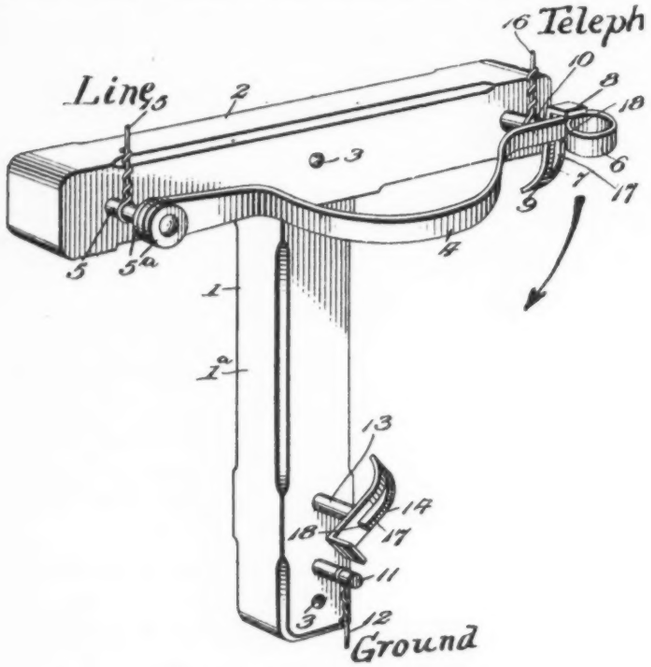
out attracting the attention of the subscriber. It consists essentially of a housing or guide 2 attached to the face of the magneto box, and containing a slide 1 which has its upper end formed with a double toothed escapement 9-10.

The lower end of the slide has a stop 6, and a similar stop 7 midway of its length, so that it cannot fall out of the housing. The escapement teeth are passed over the clapper rod of the ringer, which retains it in the upper position, its lower end being then concealed. When the

clapper rod vibrates in response to a call, the slide falls and shows its lower part as a signal.

709,351—C. B. McPherson, Telephone Switch.

This is a simple two point switch having a pivot terminal 5 connected to line, a rest terminal 10 to the telephone,

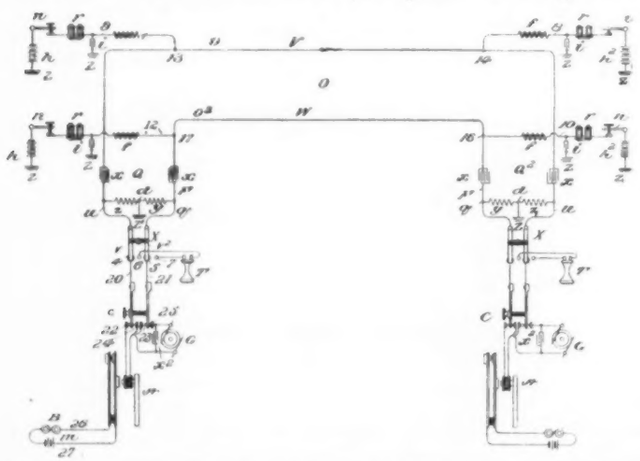


709,351. TELEPHONE SWITCH.

and a similar terminal 11 to ground, all mounted on a cross. The rest terminals have raised ribs 17 to hold the switch arm from displacement. This arm 4 is curved to have an inward tendency, and swings on the pivot 5 from one terminal to the other. In case of good weather it is turned up to connect the telephone. In bad weather it is turned down to disconnect the line from the telephone and put it to ground instead. It goes without saying that the claims are extremely specific.

709,437—J. M. Fell, Apparatus for Composite Systems of Simultaneous Telegraphy and Telephony.

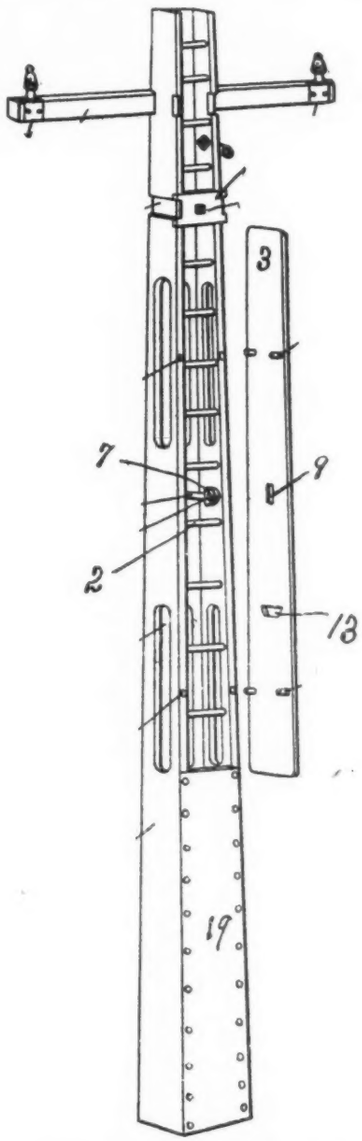
The invention in this case (the patent is assigned to



709,437—COMPOSITE SYSTEM SIMULTANEOUS TELEGRAPH AND TELEPHONY.

the American Telegraph and Telephone Co.) is very slender. It has long been common to practice simultaneous telegraphy and telephony over the same lines by separating the currents by means of condensers and inductive resistances. That is what is done here, a specific form of relay being injected into the system, to respond to calls for telephonic communication.

In the drawing V W is a metallic circuit having near each end condensers x, x, x, x, interposed in its limbs, and having its terminals at each end connected to a switch X whereby a telephone T or the call circuit 20-21 may be connected, as desired. A ringing key c is placed in the call circuit, which in the position shown connects the relay A to the wires 20-21. This relay has two springs of different weights and therefore different periods of vibration, so when an alternating current passes through the relay



709,554. ELECTRIC WIRE POLE.

the springs are vibrated, but one moves faster than the other, and they make and break in consequence, closing and opening a local circuit 26-27, to operate a signal B. When the key c is depressed it puts the generator G to line.

To telegraph over this telephone circuit without disturbing the telephonic apparatus, ground branches 8-9-10-12 are provided, each containing a choke coil f to keep out the telephonic currents and to "smooth out the telegraphic currents." Ground taps with condensers i are also provided, to assist in clearing the line and prevent sparking.

SEPTEMBER 23.

709,554—B. McFARREN, ELECTRIC WIRE POLE.

This is a hollow metal pole, formed like a box girder, of plates, and having one side cut away and provided with a detachable cover plate. This cover is shown as removed in the figure, 13 being a hole to stick in a tool for this purpose. When the cover is removed, a set of rounds 2 of a ladder are disclosed, and the pole can be ascended with ease and elegance. When the cover is put on, a staple 7 comes through a hole 9, and a padlock can be

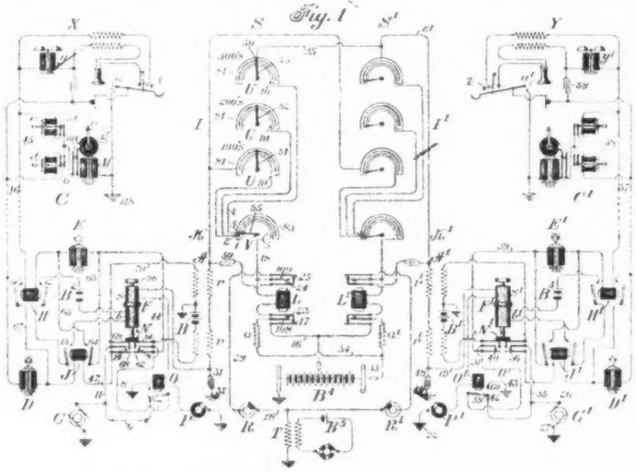


Fig. 1

709,739. AUTOMATIC TELEPHONE EXCHANGE.

applied. Thus no one can climb that pole without a key—and considerable patience.

709,739—A. M. BULLARD, AUTOMATIC TELEPHONE EXCHANGE.

The invention is directed essentially to the production of an automatic exchange apparatus that will embody similar principles, similarly applied, to those of the well known and widely used "relay type" of central office manual equipments. In other words, a bridged common battery is used for talking, with flanking choke coils, a test is provided that seems to be quite certain in its action, selective magnets and cut-off relays are substituted for the line and other relays of the manual systems, alternating current from a central generator is employed for ringing (and also for selective purposes), the subscriber's station apparatus is unchanged save for the addition of selective apparatus, listening in is impossible, and finally the familiar and often aggravating busy "tone-signal" is present in all its vigor. (Let us hope that when it is applied by a machine it will not seem so much a personal affront as when controlled by the much abused operator.)

The patent has four sheets of drawings, and to give a fairly clear idea of the invention is all that will be attempted here. The time required for reading the entire specification would be well spent, however, as the case is carefully prepared, and in keeping with the character of the invention.

The steps in the operation of this system are as follows: In calling, the subscriber sets a hand around to the first digit of the desired number, whereupon that much of the number is transmitted, then to the next digit, and so on until the entire number has been sent in; the transmission of this number, so set, works a selective switch which puts the calling subscriber's test circuit in connection with the circuits of the called subscriber, whereupon if the line wanted is not busy certain relays will complete an inductive connection through repeating coils between the lines, and the called subscriber will be rung up. On the other hand, if the line is busy, instead of completing the connection the relays connect the obnoxious busy tone-signal generator to the calling line, inductively, to apprise the caller of the condition. In calling, the subscribers have but to remove their receivers from the hooks after setting the selector; and in clearing out they have but to hang up the apparatus then automatically restoring itself throughout.

The first noticeable feature in the case is the use of alternating current for selective purposes. This is supplied by a generator at the central station, normally connected from ground to both sides of each line. In setting his selector, a subscriber puts one or the other side of his circuit to ground through a common connection controlled by a normally open circuit closer closed when the number hand is set and opened when the hand returns to zero. As soon as this circuit is closed the selective magnets at central and the restoring magnet at the subscriber's station, which are all polarized, move their respective parts, the former to set forward their switch arms, the latter to return its hand to zero. As they move synchronously the forward movement stops when the hand reaches zero, so the switches have been advanced just the distance the hand was originally advanced. This use of alternating current and polarized magnets is the refinement of designing, as all objectionable contracts are eliminated; and to make the action more certain, it is provided that several waves of current shall be required to move the various parts one step.

Referring to the diagram herewith, two subscribers, X and Y, are shown, connected to the central office by metallic circuits 45-46, and 37-38. A single description will suffice for both. At station X the talking circuit is normally open at the hook, but the ringing circuit closed as usual through

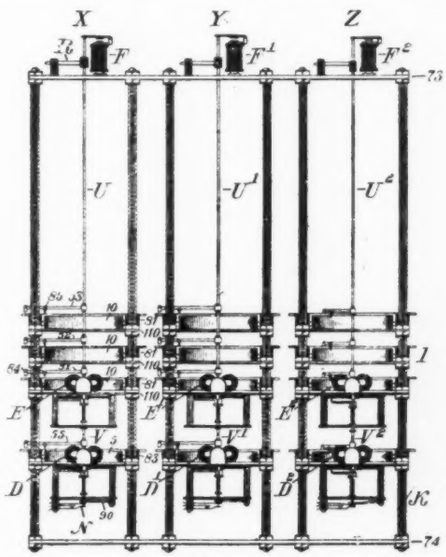


Fig. 2

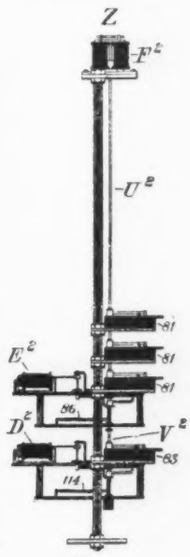


Fig. 4

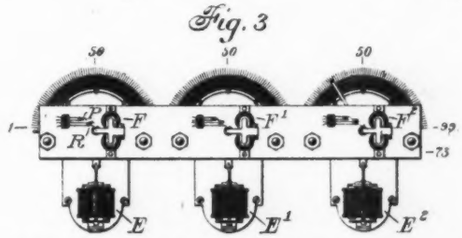


Fig. 3

709,739. AUTOMATIC TELEPHONE EXCHANGE.

the high wound ringer y and the condenser shown. The hook has an extra contact u, touched momentarily in its rising, and the up contact z is a spring so that the up contacts may be made at once, whereby the two sides of line will be put to ground for an instant when the receiver is taken down for use.

From the ground 118 a common branch passes to the magnet M and the two circuit closers 54-56, consisting of push-buttons carrying armatures of the included magnets e

and d, so that when either button is pushed it will be held in by the magnet until the circuit is broken somewhere else. By these buttons either side of the circuit may be grounded at will.

The common branch through the magnet M is controlled by a circuit closer 104, normally open, but closed whenever the hand C is set around to a number, and remaining closed until the hand returns to zero.

At the central office each line is provided with a complete switching apparatus, that for station X in the diagram being lettered S, and that for station Y, S'. Figures 2, 3 and 4 show these assembled, the parts being scattered in the diagram for purposes of clearness in reading the circuits. Referring to Figures 2 and 3, 73-74 is a frame composed of unit divisions, one for each line. These are marked X, Y, Z in these figures. In each unit division a vertical series of semicircular terminal supports, 81, 81, 81, 83, is mounted, each carrying 100 terminals radially protruding, to which the lines have multiple connections (see wire 21. Fig. 1, for station Y). Mounted vertically and centrally is a shaft U, carrying insulated arms 51, 52, 53, over the upper three sets of terminals, and a shaft V, aligned with but separate from U, carrying an arm 55 over the lowest set of terminals. This lowest set is the "hundreds" selector set, and the arm 55 is stepped around by the polarized magnet D. The upper three are unit selector sets, and arms are stepped around in unison by the magnet E, also polarized. The shafts are kept up so that terminal contacts 84 on the arms are out of connection with the radial terminals, by spring 90, overlying a spring switch N, seen in the diagram connected up. At the top of each unit or individual line division of the frame is a magnet F, which when energized forces down the shafts so that the contacts 84 come down and straddle the particular terminals they have been set over. To ensure perfect selection these spring contacts 84 are made self centering, i. e., they have tips spread apart in inverted V shape, so that when forced down they straddle the proper contacts if approximately centered over them. Slight variations from perfect synchronism between the transmitter at the subscriber's station and the selector switches are thus compensated for.

An ingenious clutch is provided between the shafts U and V, and the toothed wheels by which they are stepped around, so arranged that when the shafts are again lifted the clutches remain depressed, and springs 86 and 114 can restore the shafts to zero by turning them on their axes. When at zero the clutches automatically restore. Thus no extra magnets for restoring the parts are required.

Returning again to the diagram, line 46 of subscriber X passes to magnet D, and line 45 to magnet E at the central office. Magnets H and J work the depressing magnet F, and short-circuit the selector magnets D and E, as will appear. The line wires both pass to the switch N and thence to the repeating coil windings A, separated by the talking battery B. (It should be noted that the various batteries shown are in reality one battery.) O is a test relay, and G, G', are two positions of the same alternating current calling generator, connected between the ground and all the lines through switches N.

In operation, suppose X calls, and the desired number (Y) is 350. He first sets his hand C to 3, and presses button d, which remains depressed, a circuit being closed from ground through M, 104, 56, d, 46, D, J, 47, 68, 14, 11, G, and ground. Alternating current from G works both magnets M and D, the former to step back the hand C to zero, the latter to step forward the arm 55 on shaft V. As three steps takes arm C back, arm 55 goes three steps forward, and arm 55 is left over contact connected by wire 4 to a common contact 10 of the uppermost or third switch set in unit division S. The subscriber then sets the hand again to 50, and the same results follow, except that he has this time pressed button e, and it is magnet E that steps forward, so that arm 53 is carried around fifty steps, since it takes that many to bring the arm C back to zero. At zero the circuit is broken each time by switch 104, and the depressed button d or e then springs out.

When the operation has progressed this far the operator takes down his receiver, and the hook, in rising, puts both sides of his line momentarily to ground at u. Magnets H and J now pull up their armatures simultaneously, and local circuit 12-2-B-b-13 is closed, and magnet F forces down the shafts U and V of the selectors, so that the contacts 84 come down on the line multiples. X's test wire 18 is then connected on one side through the hundred selector 83 by wire 4 to the arm 53 and point 50 on selector 81, thence by wire 15, and 21, to Y's repeating coils r' r', and to small winding s' on Y's magnet F, to relay O', and ground; on the other side 18 is connected to the middle or 12 volt point of battery B^4, through magnet L.

If line Y is not busy, relay O lifts its armature and takes the generator connection off one side of line 41, and puts 41 to ground to bridge generator. Y's bell will be rung in consequence. Both subscribers then take down their receivers, Y's magnet F forces his shaft U down, and a talking circuit is established, connection between the repeating coils A and A' being by the following circuit: 32, 31, r, r, 30, 24, 109 (L having pulled down 109), 18, 55, 4, 53, 15, 21, r' r', 48, 49.

When the conversation is finished both subscribers hang up. Magnet F lose current, as magnets H and J are dead, the shafts spring up leaving the clutches, and are promptly spun back to zero, and all parts are again at rest.

If line Y be busy, relay L in the test circuit will not connect the talking circuits, being incapacitated in either of two ways: If Y is calling himself, there will be an interrupted return circuit to battery. If some one else has called Y, there will be such a balancing of potentials that no current will flow through relay L. In either case the contact 25 will remain intact, and the test generator B^5 will supply periodically changing current through coil T to the circuit T, 28, R (R being cut out on the shaft), 29, 25, 30, r, r, 31, 32. It will be observed that the talking contacts 24 remain open, and so a subscriber may test busy lines all he pleases, but cannot listen in.

SEPTEMBER 23.

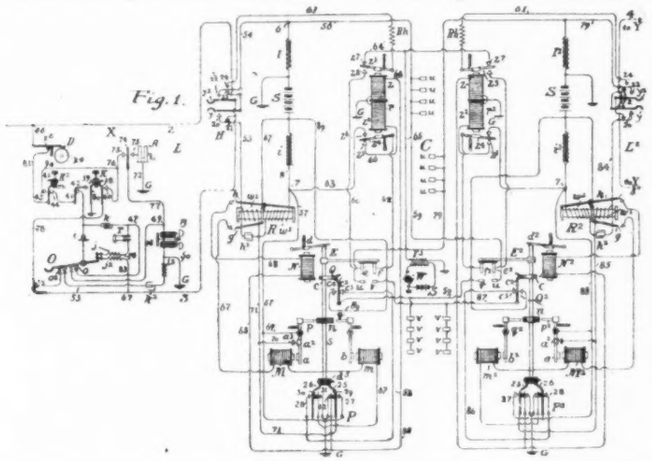
709,740. A. M. Bullard and M. C. Rorty. Automatic Telephone Exchange System and Apparatus.

This case is a companion to the one just revived. Reference is made in this as also in the other specification to a previous application of the same parties, the invention now set forth being an improvement on the one therein described.

The invention is again an automatic exchange. Common battery is employed for selective purposes and for talking, but local hand generators are used at the subscriber's stations to ring through when a connection is established. In general the central office switches are much the same as those described in the previous case, but the apparatus is intended for much smaller systems, and they are therefore smaller, while the actuating magnets are not polarized. A single selector switch belonging to one line is shown in Figs. 2, 3 and 4, herewith. Here the line terminals V are carried by the semi-circular insulating body U, mounted on metal plate Z^2. A shaft S is centrally located with regard to the terminals and carries an arm E bearing spring contacts e-f at its outer end, best shown in Fig. 4. The shaft is turned through step-by-step mechanism by magnet M, and retained by a pawl controlled by magnet m, the connections for which are shown in the diagram Fig. 1. Shaft S is also mounted to have a vertical reciprocitory movement as well as a rotary movement, using lantern or broad-faced pinions, and is controlled as to its reciprocation by magnet N. Thus magnet M steps the arm E around until the ter-

minals e-f are over the desired fixed terminals when magnet N forces the shaft down and causes the terminals to straddle the fixed terminals.

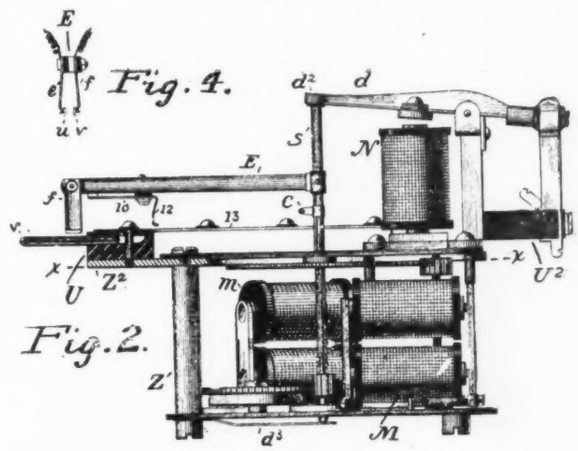
This system is especially applicable where, in small exchanges, it is desired to employ party lines. In the diagram Fig. 1, L and L^2 are line circuits, each supposed to accommodate several stations, only one of which, X, is actually shown. Here D is a make and break selective wheel. K K^2 are ringing keys. A is the subscriber's ringing generator, O the switch hook, B a high-wound ringer, T the receiver and t the transmitter. Supposing that subscriber X on line L, desires to call subscriber Y on line L^2, he first takes down his receiver and listens to ascertain if his own line is in use. He thus bridges his telephone set across the line, and current from battery S a central flows by the following path: Choke coil I, 6, 54, 22, 23, line wire 2, 46, x^6, 81, 44, 41, 42, t, j^2, 83, 67, line wire 3, 21, 20, coils w^2 and w^3 of relay R, choke coil i, and back to battery. To this steady current relay R responds by attracting both its armatures, the heavy sluggish one h, which is normally attracted to the right end of the magnet, as well as the light one g. The former closes the local circuit of depressing magnet N, while the latter closes circuit of stepping magnet M and retaining magnet m. All of these are operated once, but no effect is produced by this preliminary movement beyond the closing of spring contacts 26, 28, by cam d^5 on the shaft, whereby the ungrounded side of battery S is connected to the fixed terminals v of line L in the various switches of other lines, by the following path: S, i, 57, 26, 58, c^3 c^2, 59 to contacts v. The latter therefore have their potential raised, so that if any other subscriber

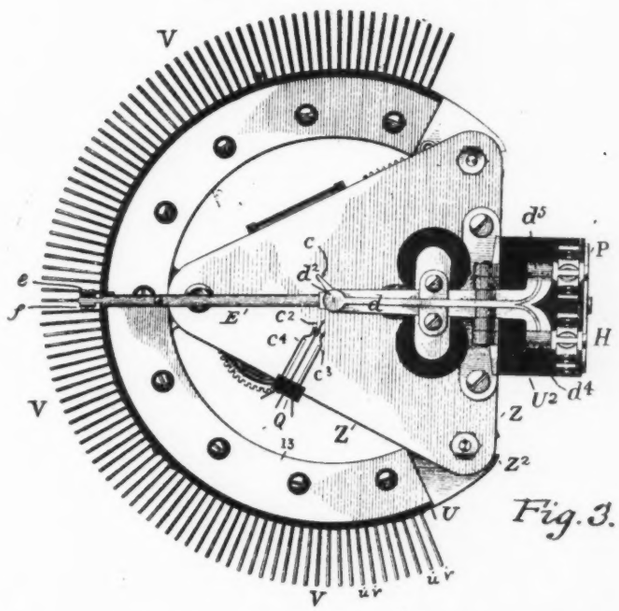


709,740. AUTOMATIC TELEPHONE EXCHANGE SYSTEM AND APPARATUS.

tries to come in on our calling line L he fails, for the following reason (involving the test): Each line is provided with a relay z, r, having balanced windings, and as long as both windings are active, the armatures z^3 z^4 will be retracted. These armatures are in the talking circuit when completed, and obviously they must be attracted and remain so to complete the through conversation circuit. Now, winding z of each relay is in series (by wire 68) with the depressing magnet N of its line, and so always gets current when the line is calling; and winding r is connected to one of the arm-contacts f. Now, if an arm is stepped around and terminals e and f brought down on terminals v of our busy line, whose potential has been raised, winding r receives current magnet z r remains deenergized, and the talking circuit remains broken, while the busy signal W. through coil I^3 at once gets in its fell work, through wire 65 to the caller attempting to get in.

If line L is not busy X sets his wheel D to the desired number and lets it go. The battery circuit is then made and broken at x^6 a predetermined number of times, working the light armature g of relay R, the comparatively quick impulses leaving the heavy armature h inactive. This works the magnets M and m, so that arm F is stepped around to the contacts of line L^2. At the last impulse the line remains closed, magnet M closes shunt 69-70, across wires 57-71, around winding w^3 of relay R, armature h lets go of the core end and is attacked by w^2, magnet N is energized, and contacts e-f are brought down on the fixed terminals u of line L^2. Now, if this line is busy, as stated, X will promptly get a busy signal. If not he presses button K, which connects his grounded generator to line wire 3, and rings. All the bells are to ground from the same





709,740. AUTOMATIC TELEPHONE EXCHANGE SYSTEM AND APPARATUS.

side of each line, but key k is used to transpose because X calls the other line without ringing the subscribers on his own line. To put him on the proper side of line L^2, having transposed once, the line L is transposed when calling at key H, at central, which is also worked by shaft s when it goes down.

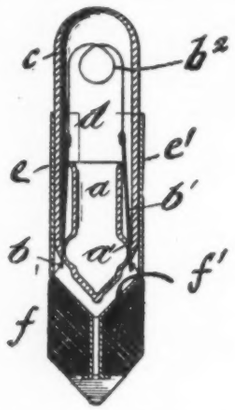
When the subscribers have finished talking they simply hang up. Magnets N, M and m let go, and springs restore all parts to normal.

To call subscribers on his own line X uses key k^2. Obviously, whenever the talking set is bridged, the line is pocketed from intrusion by the raising of potential of terminal contacts v, as described, whether the conversation is with another party on the same line, or a party on another line.

SEPTEMBER 30.

709,996—F. R. McBerty and F. H. Loveridge, signal lamp for telephone switchboards.

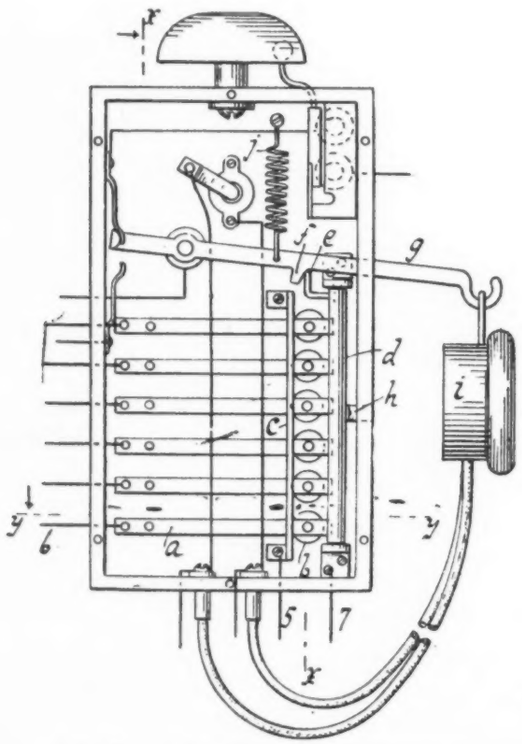
In making this lamp, the tubular stem a, having an extended bulb a', and a slightly flanged upper edge, has the leading in wires fastened to its upper edge and to the outside of the bulb, as shown. Then the cap c is put over the stem and sealed to it all around. The lower end of the



709,996. SIGNAL LAMP FOR TELEPHONE SWITCHBOARDS.

stem is left open until exhaustion, and is then sealed off as shown, leaving a teat inside the base. The upper end is left round and smooth by this means, and the filament is supported close up to it, so that the light projected through the end is a large percentage of the whole. A base block f receives the side terminals e e', between which the lamp is supported, the ends being carried through a central per-

Fig. 1.



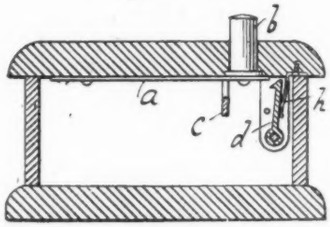
710,065. SELF-RESTORING TELEPHONE.

foration in the base, and turned over. The leading in wires are then soldered to the terminals.

710,065—L. J. Loeffler, Self Restoring Telephone.

This is an intercommunicating telephone set having the individual line wires (one for each station to all the stations) terminating in push button springs a, a, a, a, etc.

Fig. 2.



710,065—SELF-RESTORING TELEPHONE.

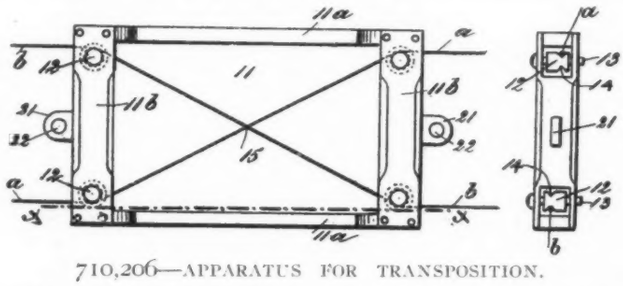
A swinging bar d has an overturned lip lying along the line of springs, and when any one of them is pushed in, it catches on this lip and remains in until the lip is retracted. The bar has an arm e extending up under the hook lever g, on which there is formed a "nose" f, to engage the arm when the hook comes down by the receiver being thereon hung. When the nose engages the arm it pushes around the swinging bar and the lip releases all the buttons in service, which thereupon fly back to normal position.

In calling the button is pushed all the way in, the spring coming down on a strip c connected to a calling battery.

710,206—J. O'Brien and J. Mattimore, Apparatus for Transposing Electric Circuit Wires so as to Equalize Induction.

These gentlemen state in their specification that it is well known that numerous troubles are due to induction in electric circuits, and "it is also a well known fact *that it is customary* to transpose * * * so as to equalize * * *" It seems to be only too well known that it is customary, as several suits are now pending, but we doubt that is what Mr. O'Brien and his friend meant.

The invention consists essentially in a frame carrying insulators whereby transposition can be practiced between poles, and thereby the distance between the transposition points be equalized, as the patentees state this to be of importance. As shown in the figures, the frame consists of side pieces 11a, end members 11b, and insulators carried

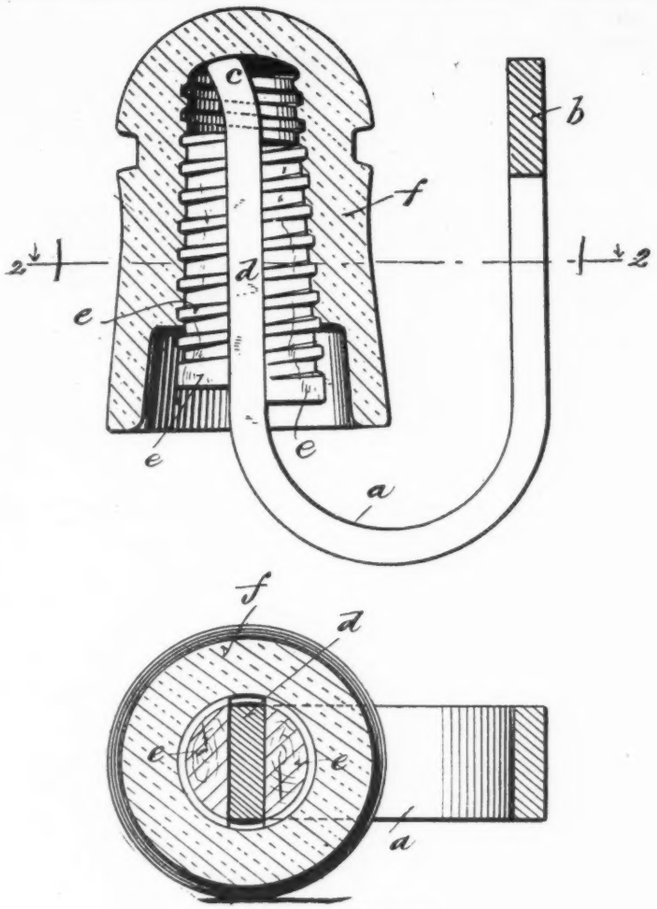


710,206—APPARATUS FOR TRANSPOSITION.

on the end members. Line wire a is brought around one insulator and diagonally across the frame, around another insulator and out. Line wire b comes in, crosses diagonally and goes out. The wires are kept in different planes by reversing the pairs of insulators relatively, so touching is prevented, and as the frame is supported by the wires a and b alone, it may be moved along to any point on the line desired by means of drag ropes attached to eyes 21-22.

710,297—R. S. Pierce, Insulator.

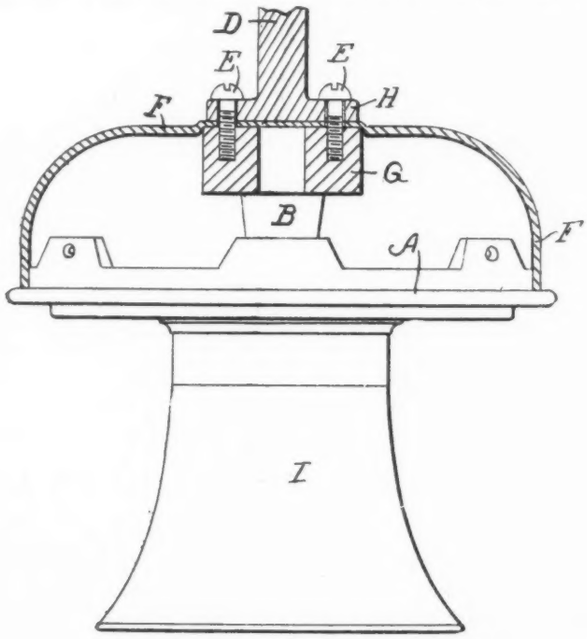
This is a simple but ingenious insulator support. The flat iron bar a is curved around so that it can be spiked to a support, such as the side of a house, and the insulator is screwed to it by putting a pair of wood blocks e-e alongside the bar, these wood blocks being commonly called segment blocks, and being threaded to fit the insulator.



710,297. INSULATOR.

710,309—M. WEISSER. TELEPHONE TRANSMITTER.

This is really a transmitter support and shell. The front plate A is carried by a spider B which has a hub G by which it is attached to the arm D, screws E E passing from

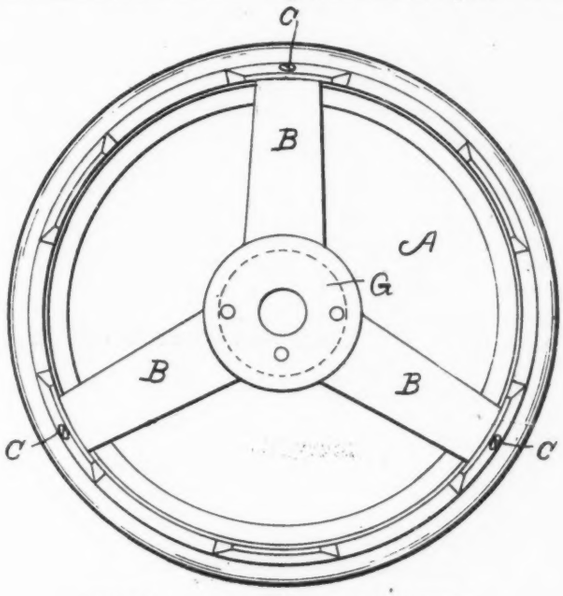


710,309—TELEPHONE TRANSMITTER.

the arm into the hub. Thus the supporting of the instrument is independent of any shell, and it is therefore possible to use a shell F of very thin and light material, placed over the spider and passing between the hub and arm at H, so that no separate fastening screws are required.

710,318, W. W. DEAN. TOLL APPARATUS FOR TELEPHONE EXCHANGES.

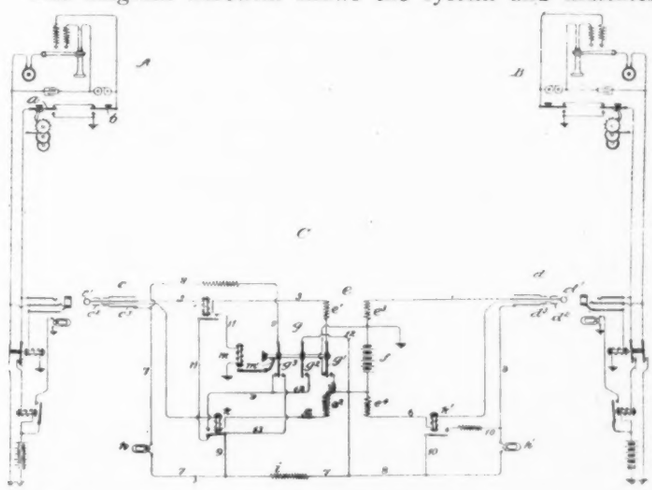
This invention contemplates the employment of a toll device at the substation of a telephone line, adapted for man-



710,309. TELEPHONE TRANSMITTER.

ual operation by the subscriber, and a "blocking device" adapted to be actuated at the central office in the course of making connection from the line in question to another to render telephonic communication over the line impossible until the subscriber has operated his toll device, said toll device when actuated serving to bring about the operation of mechanism which restores the blocking device. The subscriber may be relieved of the special act and no charge made when a connection called for cannot be made, or when the line is used in response to a call, the blocking device then not being employed.

The diagram herewith shows the system and indicates



710,318. TOLL APPARATUS FOR TELEPHONE EXCHANGES.

the mechanism, employed. Here A is a substation having the usual talking circuit and instruments, and, in addition, a toll counter worked by a key a, through a pawl taking into the teeth of one wheel of a train. The system employs centralized battery, and is of the Bell relay type. Key *a* grounds one side, 1 of line, when operated, while key b grounds the other side, 2.

At the central office the usual line jack, relay, cut-off relay and lamp are provided for the line. Cooperating with the jacks and plugs c-d, whose circuit 3-4-5-6 is divided by the familiar repeating coil e, between whose divided windings is normally interposed the battery f, so as to furnish current in parallel over the metallic circuits in both directions.

On one side of the coil e is arranged a key or "blocking device" g. This is shown in normal position, with the continuity of the circuits restored. In the two sides of the cord 3 and 5, two relays l and k are respectively connected. The blocking device consists of a stem-carrying contact g^1 g^2 g^3, connected to soil e' (and cord conductor 3); to the underground side of battery by wire 12; and to shunt resistance 9, in the order named. A push head on the stem serves for manipulation, and a shoulder cooperates with the pawl m', controlled by magnet m, itself in a local circuit 11, closed when relay l is active and relay k inert, as follows: Battery f, 7, i, 9, 11, m, ground. The conductor 7 also connects with the usual lamp branch containing lamp h, and completed to the sleeve of jack and through cut-off relay to ground when the plug is inserted. 9 is a shunt about this lamp.

When A calls, and plug C is inserted, after the operator ascertains if the wanted line is free, the plunger g is forced in, the pawl m' falls behind the shoulder and coil e', while connected to e^2, is to the same side of battery. Wire 12 is completed through to 9 and relay k, and both relays k and l are deenergized. Subscriber A can thus hear B speak when he answers, but cannot speak to him, having no battery, until he has pressed button a, which at once registers the call, and, by grounding line wire 1, closes circuit from battery f through relay l, thereby closing local circuit 11, energizing magnet m, and releasing the plunger g, which promptly restores the battery so that A can talk. Key *b* at the substation calls the operator, by causing relay k to close shunt 12 about resistance i, thereby lighting lamp h.

710,333. F. R. McBerty. Selective Calling Appliance for Telephone Lines.

This is a selective ringing key for party lines, having an indicator to show which key was worked, or which party

Fig. 1

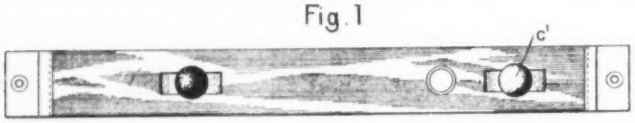


Fig. 2

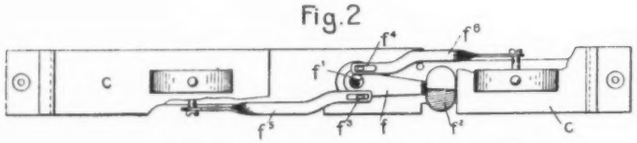
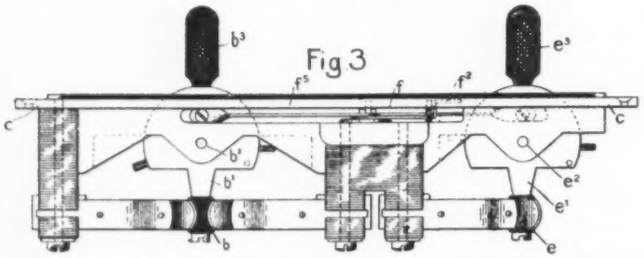


Fig. 3



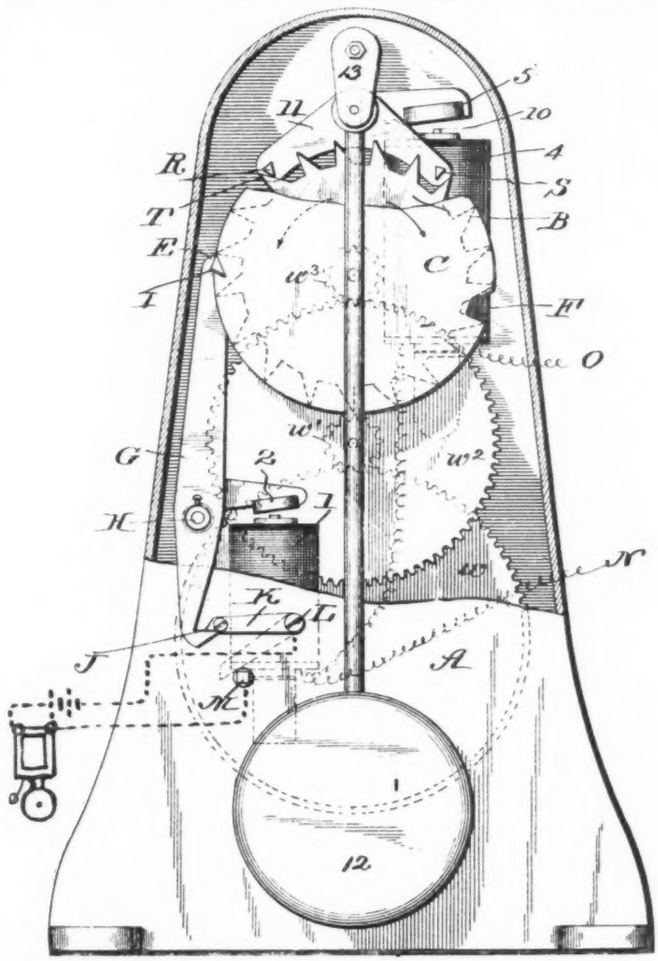
710,333. Selective Calling Appliance for Telephone Lines.

rung last, so that if another call becomes necessary no mistake need be made.

The key is a double one, with one combination listening and ringing end, and one plain ringing. The selection of parties is by using one or the other of the levers b^3 or e^3, and in order to mark which of these is last used, an indicator arm f is pivoted at f, under the cover plate, having a parti-colored target f^2. Each of the key discs, b' and e' has a link connection f^5 or f^6, to the lever arm, so that when one key is used the target is swung one way and then the other way. Slots in the links give lost motion to allow the keys to move freely; and a window in the cover plate shows the target.

710,335. W. Palmer Jr. Selective Call for Telegraph or Telephone Lines.

This is a selective device for party lines—primarily for way stations on telegraph lines. The scope wheel B is impelled by a clock train, spring or weight driven and governed by the pendulum 12. The train turns a disk C, having a locking notch E, in which the dog I on locking lever G normally rests and a "ringing notch" F, which is a different number of steps from the locking notch in each station. Locking lever G is pivoted at H, and normally holds up drop K, which when it falls on M closes the bell circuit.



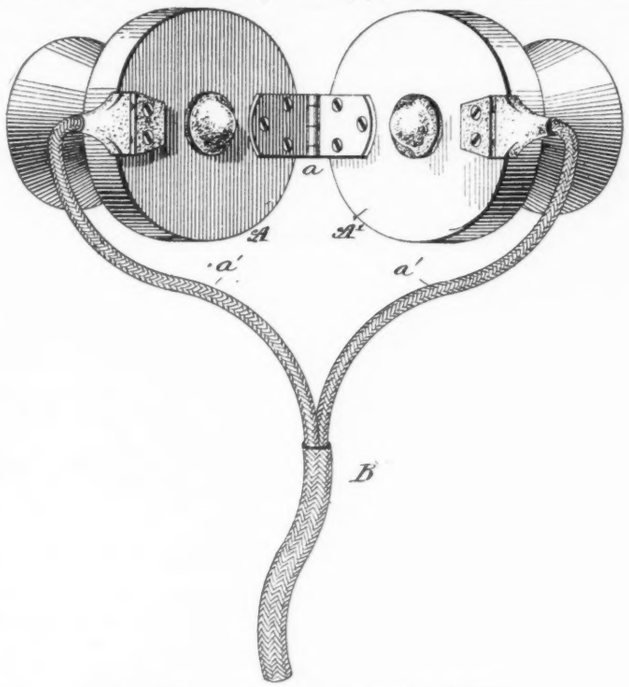
710,335. Selective Call for Telegraph or Telephone Lines.

To call a succession of short impulses in one direction are given, the armature 5 of magnet 4 having a pin and slot connection with the pendulum, so as to give lost motion, and at the beginning in starting the pendulum to turn wheel C back a little, so dog I can be lifted out of notch E. Successive swings of pendulum 12, then step around the disc C, until the required number of steps to bring the notch F under I at the wanted station. The circuit is closed at that instant, armature 2 is drawn down, drop K falls on M, and the bell rings. At all other stations the clockwork runs on until the locking notches are reached again by dog I.

OCTOBER 14.

710,979. M. R. HUTCHISON. TELEPHONE TRANSMITTER.

This invention relates to microphones used instead of horns or ear trumpets by deaf people. It consists essen-

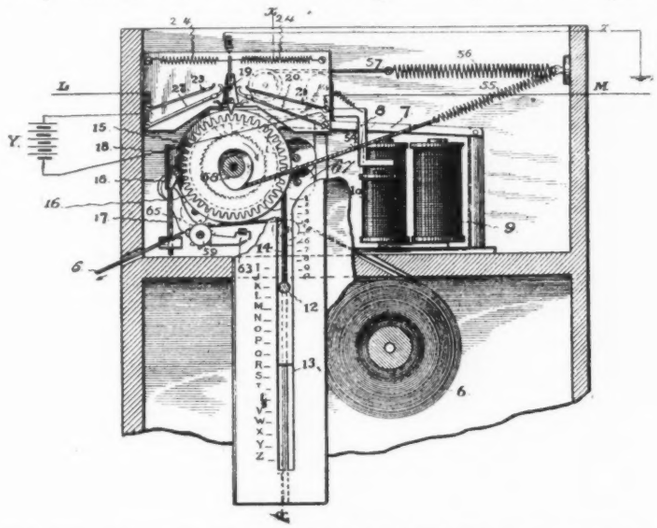


710,979. TELEPHONE TRANSMITTER.

tially of two transmitters hinged together so they can be held in the hand and turned in any direction desired.

711,453. W. F. SMITH, MESSAGE TRANSMITTING AND RECORDING MECHANISM FOR TELEPHONE SYSTEMS.

This invention contemplates the provision of a complete printing telegraph outfit at each telephone station, whereby may be transmitted "words to form a sentence or arbitrary combinations of letters or figures to produce a cipher



711,453. MESSAGE TRANSMITTING AND RECORDING MECHANISM FOR TELEPHONE SYSTEMS.

message," and means to record "the same in permanent form on a paper tape."

There is nothing broadly new in the apparatus. In fact it is a usual type of printing telegraph, with step by step magnet in one side of the circuit, printing magnet in the other, a vibratory transmitter 19, and a selective controller therefor consisting of a handle 12 moved up and down in a slot in the face of plate 13, the latter bearing inscribed numbers or letters to guide the hand in forming the "cipher message." A double type wheel is employed, with letters on one side and figures on the other, as in the familiar "tickers."

CHICAGO'S TELEPHONE TUNNELS.

Twelve miles of the wonderful system of tunnels in the downtown district designed for the wires of the new Illinois Telephone & Telegraph Co. have been completed. The original plans, in all probability, will be much extended, and may bring the big bores into districts adjacent to the business section bounded by 12th street, the north and south branches of the Chicago river and Lake Michigan. Officials of the company hope to have 25,000 telephones in service by the middle of May.

The company's franchise gives it the right of constructing conduits to carry its wires, and that was the original purpose, but the possibilities of the thing became so impressive that the company intends to carry freight, mails, newspapers, packages and other articles through the tunnels.

At present, with a system of trams, the company could deliver coal at the downtown offices, transfer freight from the railroad depots to the retail concerns, take merchandise from the shops for delivery to any part of the city, and handle almost everything else not too bulky.

The company believes the franchise will be extended to include the desired privileges. The present charter includes the transmission of the mails. The company also wants the privilege of renting space to other corporations having telephone and telegraph wires. The bores are sufficient to take care of all the wires in the city.

If the franchise is extended satisfactorily the company will rent storerooms in various parts of the downtown district, dig shafts down to the tunnels, and hoist freight by elevators. Merchants will have bores constructed from the main tunnels to their basements. Generally speaking, merchants are heartily in favor of granting the extra privileges.

In order to make effective its plans the company will have to enlarge the tunnels 12 by 14 instead of 6 by 7 feet. With enlarged tunnels passenger traffic in addition to freight business could be cared for. The passenger business, however, is not contemplated at present.

The highest grade of the system is 27 feet below the surface and the lowest 40 feet. The Chicago river will be tunnelled to a depth of 65 feet, 25 feet deeper than the present tunnels. It is expected every thoroughfare north of 12th street, the southern boundary of the so-called central district, and east of the Chicago river will be completed by January 1st.

The streets tapped include almost all in the prominent parts of the business district.

Experts say the system of tunnels is one of the greatest engineering accomplishments ever attempted. Chiefly Easteners are interested financially in the project. The capital is $5,000,000 of stock and $5,000,000 of bonds, the former having been placed in a voting trust, thus securing permanent control for the present management.

The official annual report of the principal telegraph corporation in America recently issued, shows an increase of more than $1,700,000 in gross receipts and more than $700,000 in net earnings. These figures do not indicate that the telegraph business in the United States has been made unprofitable by the improvement and development of the telephone service and it is quite evident that the telegraph will not be displaced by the telephone for some years to come.

Profitable Telephone Rates.

FRED DE LAND.

Cost-finding and cost-keeping are two rocks on which many an enterprise has been shipwrecked. To know what the actual cost of production and the actual cost of delivery are, that is, to comprehend and understandingly combine all the elements that enter into the cost of producing and supplying telephone service, is to have a broad and strong foundation for a new enterprise.

Dr. Herr declares that many Independents "under-estimated the cost of maintaining a telephone system and, consequently, made the rates much too low." How did this misunderstanding come about? Mr. Bickel says that "the telephone business is exceedingly fascinating—has many points of advantage over ordinary mercantile pursuits. Yet, taken as a whole, *the telephone business of the country is in a more chaotic condition* than that of any other public service."

Why should the telephone business be in a chaotic condition? Is it not largely due to the fact that in establishing rates so widely at variance with Bell rates, the Independents ignored or overlooked or were led to believe in the non-existence of two definite and legitimate charges against operating expenses, and two direct charges against cost of construction, namely: (1) A maintenance charge against operating expenses covering repairs, renewals and depreciation to an extent that will at all times maintain the plant in as good a condition as when it was first built; (2) a reserve fund for deferred or contingent maintenance; that is, for use in the event of a disastrous storm, or of the necessity to replace the present switchboard and subscribers' equipment with more efficient and more productive apparatus. Then against cost of construction are the legitimate charges of (1) engineering expense, and (2) of permanent right-of-way.

Dr. Herr told the Independents at Chicago that "the Bell company had tabulated the cost of construction and running expenses, and knew well that the price at which their competitors began doing business would be insufficient to maintain the business when the number of subscribers increased to the point that would be considered real competition." Yet the discussions at association meetings have brought out the fact that the majority of the Independents do not count depreciation or renewals as an expense, but charge both into construction and then capitalize the amount. This may be a satisfactory method if there is no desire to provide against impairment of capital by an overestimation of profits; but the intelligent leaders in the Independent field, who have no desire to be dishonest with themselves, know full well that every dollar that is charged to investment when it should be charged to operating, directly impairs the capital to that extent, and sooner or later will have to be made good. They know, too, that the cost of permanent right-of-way is constantly increasing and becoming more difficult to secure, as Mr. Critchfield clearly pointed out at the Buffalo meeting.

What would be the commercial standing of a firm who would agree to sell all the product of its factory, not only at a price one-half to two-thirds below its competitor, but at a rate that did not cover the cost of preparing to produce it, to say nothing of the cost of delivery? Many would say that they were either ignorant or were playing a game that has failed more often than it has succeeded.

Mr. Fennell has explained that "the importance of reasonable rates is demonstrated from the fact that *unreasonably low rates do more harm to Independent telephone companies than any other one cause, more even than competition with a strong company,* as without money they cannot successfully compete. And he shows how "in embarking in the telephone field instead of computing the charges to be made for service, the cost of operating, amount of depreciation, amount of money on which interest had to be paid and basing the rates accordingly, the rates demanded by local parties and what are being charged in other exchanges are often taken as a basis. Thus charges in a great many instances are altogether inadequate, with the result that the service deteriorates, thereby inviting competition and jeopardizing the ultimate success of the exchanges; the enterprise which started well becomes a loss, when a little careful consideration on the part of those interested would prove conclusively that it would be better not to operate at all than to do so at rates below cost. Results of this kind not only affect the principal exchanges or toll lines in connection with which the error is made, but have a widespread influence by *tending to reduce the confidence of capitalists.* . . . From the millions of capital being annually invested in Independent telephone construction, good results should accrue, but no amount of capital invested in an exchange or toll line can make it a success unless such charges are made for the service as *will pay all expenses* with a reasonable profit, particularly as *there are contingencies in the telephone business greater than in any other.*"

In June, 1899, the *Telephone Journal* editorially said: "We do not believe there is any profit in operating the average Independent telephone exchange at rates less than $24 and $30. If the number of subscribers exceed four hundred, we believe the rates should be not less than $30 and $40, and where there are 1,000 subscribers, the rates should be $36 and $48. With 2,000 subscribers, rates should be made to cover local conditions, but should not be less than $50 and $60; where there is an unusual amount of underground work even these rates should be increased."

The editor of *Electrical World* believes that "the great overhanging problem in telephony is how to maintain a margin of profit as the business grows. To keep ready the plant that will enable 5,000 subscribers to talk to each other is to us and others obviously much less expensive than to provide and maintain the plant that will give 50,000 subscribers the same swift intercommunication. In other words, the 'stand-by' charges grow out of all proportion to the possible return on any one call, and in this respect telephony is by no means alone. To go no further than the field of electricity, it is a notorious fact that the cost of telegraphic operation has steadily gone up, with a lessening profit on a larger volume of business; and the problem in electric lighting to-day in great cities is to so adjust the tariff that the increasing cost of the 'stand-by' charge for plant and operation shall be borne fairly by the consumers. It might be urged that telephone exchanges should therefore be kept down to a certain size, but that evades the point, namely, that the value and efficiency of the system consists, not in being limited, but in being able to reach every one of the other 50,000, if and when desired. The larger the city, the greater the number of possible subscribers, all to be put in touch; and there seems no way of getting around the difficulty."

Two years ago, Mr. Willard P. Beardsley, a leading Independent in Pennsylvania, in telling how Independent interests were "outflanking the Bell," said: "When we gave to the people an equitable telephone rate consistent with the expense of operation and maintenance, the Bell people ridiculed, scoffed and even threatened us, but we fought them with never ceasing vigor, until to-day—well, you know the rest; we are still in business with no retardation to our progress." But only a few months later, this same Mr. Beardsley wrote about "the failure of most Independent companies to take into deep consideration the cost of operation and maintenance, some having the idea that after the

telephone has once been installed, it should never need attention. Of other mistakes made by new companies, possibly *chief among them is the low rates universally adopted, $24 and $18.*"

In other words, the "equitable telephone rates we gave to the people" were not equitable to ourselves. Now, if Mr. Beardsley considered that the chief mistake "is the low rates universally adopted, $24 and $18," what excuse can we find for investments based on these low rates, after an investigation showed that two hundred and nineteen cities, towns and villages in Ohio were supplied with Independent telephone service at residence rates of $12 a year, or less, and regarding which the investigator reported that "there are some exchanges in the state whose rates are too low to maintain first-class service." That is, at fifty per cent less than the residence rate of $18, which Mr. Beardsley declared was the chief mistake of new companies.

It is well to remember, too, that Mr. Beardsley added: "There are exchanges being installed to-day by companies, who, disregarding the experience of others—and who by the way, have paid dearly for such experience—are starting where the others started, instead of profiting by their loss and beginning where they left off."

Although the testimony of many Independents could be presented to the effect that many existing rates are too low to yield any profit, we need consider but one more. The Iowa Independent Telephone Association held its convention in Des Moines in March. At that meeting, Dr. Henry S. Herr, a leading Independent of Iowa, declared that "the Independent people went into the telephone business as pioneers go into unexplored countries—not knowing what was before them—and they have learned many things. First, that many underestimated the cost of maintaining a telephone system, and, consequently, made the rates much too low. If the rates charged by the old company in 1892 *had been cut just one-half,* the people would have been just as well satisfied, and many companies could now live who are dying of consumption, the rusting of wires, decaying of telephone poles and antiquated switchboards, and who, like Mrs. Gamp, would buy a new frock if they had the money to pay for it." And at the Chicago convention, only two months later, this same honest Dr. Herr told the delegates, "I have come to the conclusion that the rate should have been established at about *three-fifths of that of the Bell companies, all things being equal,* which would give *a bare remuneration on capital invested.*"

Now, these few facts out of the many that could be presented, make clear that Independent men who do their own thinking, and are honest with themselves and the public are publicly admitting that the Independent telephone rates are far too low to yield any profit on the investment. If this is so, let us first endeavor to ascertain how much too low, and then further ascertain what course of action, based on past experience in various cities, is advisable for Independents to take if they desire to attain success.

By reason of proposed legislative action, a careful and thorough investigation was made of the records of a number of Bell companies, covering a period of more than fifteen years, to ascertain the average cost of supplying telephone service in cities of various sizes, that is, so much of the cost as "included only the expenses incident to operation and maintenance, general expenses and taxes, but not including interest charges, appropriations for sinking fund, contingent liabilities, or dividends." And while it was found that the Independent movement had brought about a pronounced economic advantage to the Bell in causing it to increase its systematic watchfulness over every element entering into the problem of the cost to produce, the cost to market and the cost to deliver telephone service, yet the annual costs brought out by this thorough investigation were so much higher than the rates of the Independents as to fairly daze holders of Independent securities.

And that these facts were probably known to Independents is shown by the statement made at the Buffalo convention, where Mr. E. B. Fisher, a leading Independent of Michigan, portrayed the Independents' "lack of system, their lack of carefully analyzing conditions and experiences and then making systematic deductions therefrom; learning from sad personal experience, rather than from profitable observation, of what had already been *'threshed out'* in the evolution of the Bell system."

The annual report of the parent Bell company, for the year ending December 31, 1885, seventeen years ago, reads: "With longer experience the telephone companies have learned that the cost of maintaining and reconstructing their plant has been generally underestimated, and many of them have in consequence been forced to recognize that the profits upon telephone business are less than they had expected and believed." Evidently Mr. Fisher knew of this, and similar reports.

To return to the results of our legislative investigation, which showed that the average cost of supplying telephone service per subscriber per year, we find the following:

In cities similar in size and importance to Buffalo, Cleveland, Cincinnati and Pittsburg from $60 to $65.

In cities similar in size and importance to Rochester, Toledo, Indianapolis and Columbus from $48 to $51.

In cities similar in size and importance to Evansville, Erie, Fort Wayne, Youngstown and Akron, from $37 to $40.

In smaller cities, the average cost ranged from $26 to $32, depending upon the size of the city and conditions governing the installation.

Now let us tabulate this average cost, together with the Independent rates and the Bell rates as shown in that reliable and widely published "compilation made by Mr. E. C. Bickel, a pioneer Independent manager," for the Federal Telephone Company, under the title of "Ohio Telephone Facts," and observe what the results are. But let us bear in mind that in his compilation Mr. Bickel said: "There are some exchanges in the state whose rates are too low to maintain first-class service; yes, lower than the public demands. Experience will rectify these and work no hardship to any one. One-half of the old Bell rates is about a fair rate for stockholder and subscriber."

Section 1 shows the Bell rates in 1895, as recorded by Mr. Bickel.

Section 2 shows the Independent rates in 1901, as recorded by Mr. Bickel.

Section 3 shows what the rate would be if "one-half of the old Bell rate" was charged as suggested by Mr. Bickel.

Section 4 shows what the rate would be if "three-fifths" of the old Bell rate was charged, as suggested by Dr. Herr.

Section 5 shows the average actual cost per station per year, to supply telephone service, not including interest on bonds, dividends, sinking fund, etc.

Section 6 shows the maximum average rental per station possible to receive if existing franchise limitations are not repealed.

Section 7 shows the actual average rental received per station per year according to financial statements issued.

TABLE NO. 1.

	Sec. 1.			Sec. 2.		
	Res.	Bus.	Aver.	Res.	Bus.	Aver.
Cleveland	72	125	$98.50	36	48	$42.00
Columbus	54	72	63.00	24	40	32.00
Youngstown ...	48	72	60.00	18	25	21.50
Akron	36	60	48.00	20	32	26.00
Portsmouth ...	30	36	42.00	18	24	21.00
Salem	24	36	33.00	18	24	21.00
Lancaster	24	36	30.00	12	24	18.00
Bowling Green.	24	36	30.00	12	18	15.00
Shelby	18	36	27.00	6	12	9.00

Sec. 3. Average.	Sec. 4. Average.	Sec. 5. Average.	Sec. 6. Average.	Sec. 7. Average.
$49.25	$59.10	$61.50	$42.00	$32.30
31.50	37.80	49.50	32.00	29.62
30.00	36.00	38.50	21.50	20.74
24.00	28.80	37.00	26.00	22.86
21.00	25.20	32.00	21.00	19.70
16.50	19.80	31.00	21.00	20.08
15.00	18.00	31.00	18.00	16.79
15.00	18.00	29.00	15.00	13.47
13.50	16.20	26.00	15.00	

Glancing at Sections 1 and 2 in Table No. 1, we are led to wonder if the only explanation possible for the wide difference in the average rate of Bell and Independent service is that the people were so foolish as to believe that "one-half the Bell income was profit," as has been claimed by Independents, or are there legitimate items included by the Bell that were overlooked by the Independents when establishing rates? Do the Independents include items covering proper maintenance and depreciation charges when establishing rates? Or do they accept the statements of the public that "$12 a year is enough to pay for a telephone?"

Now to cover proper maintenance and depreciation charges only, an amount is set aside each month by many Bell companies ranging from thirty-five to forty-five per cent of the gross revenue; and this percentage is based on the higher rates received by the Independents which, in many instances, do not equal the sum that is included in this Bell percentage for maintenance alone.

In order to enable a fair comparison to be drawn between the items entering into the expense account of Independent and of Bell operating companies, it seems wise to reproduce extracts from the financial statements of three Bell companies for the year 1900, which we will designate as the Northern, the Southern, the Eastern, respectively. From this presentation of these published reports you will observe that while each Bell company maintains its own system of accounting, that all are financed with a view to maintaining the plant so that its earning power shall never be impaired, or the integrity of its investment be undermined. And the true reason of this method is that Bell exchanges represent an actual cash investment by stockholders exceeding the total investment made by bondholders and the stockholders expect and are justly entitled to a fair return on an investment in an industry that is yet "in a transition stage."

TABLE NO. 2.

THE NORTHERN BELL COMPANY.

Earnings:		
Exchange service	$ 207,203.97	
Toll service	135,387.40	$342.591.37
Expenses:		
Operating expenses	$ 104,471.26	
Maintenance and reconstruction	103,228.89	
General expense	47,675.98	
Taxes	11,700.00	$267,076.13
Earnings over operating expenses		$75,515.24
Liabilities:		
Capital stock	$1,000,000.00	
Bonds	991,500.00	
Sinking fund	325,000.00	
Reserve	20,529.92	
Surplus	62,038.82	

TABLE NO. 3.

THE SOUTHERN BELL COMPANY.

Earnings:		
Exchange service	$1,335,593.85	
Tolls	476,469.87	
Private lines	2,863.04	$1,814,926.76
Expenses:		
Operating expenses	$ 309,539.04	
Maintenance and reconstruction	734,545.25	
General expense	154,137.85	
Taxes	88,074.51	$1,286,296.65
Earnings over operating expenses		$528,630.11
Liabilities:		
Capital stock	$6,017,700.00	
Bonds and debentures	1,375,000.00	
Surplus	564,562.07	
Reserve for deferred maintenance	572,621.34	
Reserve for contingent liabilities	59,576.00	
Undivided profits	105,309.75	$8,694,769.16

TABLE NO. 4.

THE EASTERN BELL COMPANY.

Earnings:		
Exchange service	$1,372,916.29	
Pay stations	356,560.11	
Tolls	965,341.18	
Private lines	22,275.33	$2,717,092.91
Expense:		
Operating	$ 460,839.58	
Maintenance	727,508.05	
Reconstruction	120,140.58	
General	504,613.20	
Taxes	102,459.39	$1,915,560.80
Earnings over operating expenses		$ 801,532.11
Liabilities:		
Capital stock	$7,665,600.00	
Bonds	1,339,000.00	
Surplus	2,076,609.56	

It would also seem that this presentation bears out President Hadley's statement that "if a man obtains a large income, in nine cases out of ten it is because he furnished something that society wants; if this income leaves him a large margin of profit, it is because he has known how to economize social force in doing the work. The theory of value and of commercial justice which puts a premium on work of this kind is *far better for the community* than that which in its pursuit of distributive equity, is ready to sacrifice collective efficiency and economy."

Taking these three financial statements and tabulating the percentages to total earnings of operating expense, maintenance and reconstruction and general expense, we secure the following results:

TABLE NO. 5.

PERCENTAGES TO TOTAL EARNINGS.

	Northern Company.	Southern Company.	Eastern Company.
Operating	30	17	17
Maintenance and reconstruction	30	40	31
General	14	8	18
Total	74	65	66

In Table No. 5 we find an average of thirty-four per cent of the total earnings expended on maintenance and reconstruction, and further find that an average of sixty-eight per cent of the earnings is required for operating, maintenance and general expenses, not including taxes. That is, an average of sixty-eight per cent of the earnings from Bell rates, which in many cases are from 100 per cent to 300 per cent higher than the Independent rates. How much higher than many Independents dream this percentage really is, may be apparent from the statement that the average annual cost of operating for these three companies was $10.73 per subscriber, the average annual cost of maintenance per subscriber was $17.24, and the annual average general expense per subscriber was $7.95, not including

taxes, royalties, rentals, interest and other items properly chargeable to other accounts. This makes an average expense of $35.92 per subscriber, for a total of over 102,000 subscribers situated in large and small cities, towns and villages, not including the other items mentioned.

The reports of the three Bell companies tabulated are the only available reports, or I would gladly give others. But in order that you may perceive that they are neither poorer nor better than the average Bell reports, I extract the following from a letter written by a banker in New York:

"It is not possible to give the exact earnings of all the Bell subsidiary companies, some of them not reporting for the public. The following statement, however, represents combined earnings of nineteen licensee companies of the Bell for the year ending December 31, 1899. These nineteen companies represent 430,341 subscribers of the whole number of 632,946 at that date, or 68 per cent of the whole." And he adds: "A most vital point in the financial operation of the sub-companies is that thirty per cent of their gross earnings is charged to maintenance, which forms a part of their operating expenses and is so charged in every case."

Tabulated, the financial data compiled from the reports of these nineteen Bell companies, reads as follows:

TABLE NO. 6.

Gross receipts	$20,802,998
Operating expenses	14,589,213
Net receipts	$ 6,213,785
Interest charges	802,223
Divisible surplus	$ 5,411,562

That the cost of operating in these cases is exceptionally low is evidenced in the sworn testimony given in the Washington case, where a thorough investigation by, first, a congressional committee, and later expert accountants showed that the single item of salaries and wages during the six years from 1892 to 1897 averaged $35.70 per telephone, with an average of 1,825 subscribers, and in 1898, with an average of 2,126 subscribers, this one item averaged $38 per telephone. And the total average expense per subscriber during those six years was $66 per telephone, without any allowance for profit or depreciation. But then Washington is peculiarly situated in respect to cost of supplying telephone service, and the expense will naturally be higher there than in some other cities having the same number of inhabitants.

Dividing the above items by the total number of subscribers, 430,341, we obtain the following ratio per subscriber:

TABLE NO. 7.

COMBINED NINETEEN BELL REPORTS.

Gross receipts	$48.34 per subscriber
Operating expenses	33.91 per subscriber
Net receipts	14.43 per subscriber
Interest charges	1.86 per subscriber
Divisible surplus for dividends	$12.57 per subscriber

Thus, these combined nineteen reports show that the average percentage of operating expenses to average gross receipts is seventy per cent, where the average income is $48.34, which is double the average income reported by many Independent companies. Hence, on this basis, which is just and reasonable, the average percentage of operating expenses to average gross income in many Independent companies should be 140 per cent where the average income per subscriber is so low as $24.17 a year.

Now let us compare some reports received from Independent companies with these Bell reports. In table No. 8 we have the combined totals reported by seventeen Independent companies.

TABLE NO. 8.

TOTALS OF REPORTS FROM SEVENTEEN INDEPENDENT TELEPHONE COMPANIES.

Earnings March, 1902:		
Exchange subscriptions	$63,173.80	
Toll earnings	8,442.07	$71,615.87
Expenses:		
Operating	$13,721.35	
Maintenance	$16,763.31	
General	8,955.11	
Taxes	3,469.77	$42,909.54
Earnings over operating expenses		$28,706.33

Percentages.

	Per cent.
Operating to total earnings	18
Maintenance to total earnings	23
General to total earnings	13
Total	54

Table No. 8 shows that the seventeen Independent companies devoted an average of only fifty-four per cent of the total earnings to operating, maintenance and general expense, as against an average of sixty-eight per cent devoted by the Bell companies cited. The table further shows that an average of only twenty-three per cent of the earnings of these Independent properties are devoted to maintenance, as against an average of thirty-four per cent devoted by the Bell. That is, the Independents' average for maintenance must be increased fifty per cent to equal the Bell average. Moreover, it must be borne in mind that the Bell income per subscriber is from fifty to seventy per cent greater than the income per subscriber in these seventeen Independent properties. Hence, were the maintenance expenditures of these Independent properties increased 100 per cent, it is doubtful if the average maintenance expenditure per subscriber would equal the present average maintenance expenditure per Bell subscriber. Yet the experience of years has demonstrated that the larger expenditure is an absolute necessity, if the earning power of the property is properly maintained.

And this brings up the question whether the proper percentage of expense of maintenance to earnings is only a question of proper rates? That is, with average rates of $24, the proper maintenance charge would probably be eighty per cent, while with average rates of $48, exactly the same relative expenditure would only mean an average maintenance charge of forty per cent of the earnings. Hence do not forget that the question of proper percentages bears a very close relation to proper rates, if proper deductions are to be drawn therefrom.

According to the *Scientific American*, several London hospital surgeons are now using the telephone whenever they have occasion to probe for bullets or other metallic objects embedded in the body of a person. The receiver of the telephone is placed on the head of the operator, and the patient is placed in the usual manner, in contact with a plate, the general medium employed being a wet sponge or some paper saturated with a saline solution, which is spread over the plate. The latter is connected with a telephone by wire, and the probe, after it has been introduced into the body, vibrates as soon as the foreign metallic substance comes in contact with it. The probe is also connected with the telephone by a wire, and thus no such blunder is possible as sometimes happens when the ordinary battery is used. When a telephone is used in this way, the plate acts as one pole and the probe as the other. Needles, bullets, grains of shot and pieces of steel and copper have been easily located by use of this simple method. The only instances when the telephone does not work satisfactorily are when the objects to be located are of the same metal as the probe. French and German physicians have been following these experiments in London with success.

PERSONAL

Albert J. Heitz has accepted the management of the Home Telephone Company at Vincennes, Ind., succeeding Henry Petts.

Victor C. Gilpin has been assigned a position as sales manager of the DeVeau Telephone Manufacturing Co., New York City.

H. J. Blanchaine of Laporte City, Ia., has assumed the management of the Jasper County Telephone Company's plant at Newton.

S. C. Crofford, formerly Ohio representative of TELEPHONY at Cleveland, Ohio, visited Chicago about the middle of the past month.

Julius Rumple, manager of the Western Telephone Company, Weston, Mo., visited Chicago manufacturing concerns during the past month.

D. D. Mitchell has been appointed manager of the North Vernon (Ind.) exchange and will have supervision of the entire plant of this company.

J. P. Witwen has disposed of his interest in the telephone manufacturing company, Baraboo, Wis., to J. W. Whistler, who will continue the business.

W. H. Crumb of the firm of W. H. Crumb & Co., Chicago, is superintending the installation of the new Yankton Telephone Company at Yankton, S. D.

E. Funkhouser, formerly manager of the Consolidated Telephone Company, Fairmont, W. Va., resigned his position October 1st and has been succeeded by C. W. Evans.

W. F. Malloy, secretary of the Bridgeport Brass Company, after an extended and quite severe attack of rheumatism has resumed his duties at the company's New York office.

J. B. Ware, manager of the People's Telephone Cimpany, Detroit, Mich., is now at Springfield, Mo., superintending the construction of a telephone plant for Alma and St. Johns capitalists.

H. B. Tubbs, manager for four years of the Newcastle (Pa.) Telephone Company, has tendered his resignation to take effect November 1. H. Adams has been appointed to succeed Mr. Tubbs.

J. Q. Stanley, formerly manager of the Brockton office of the Southeastern Missouri Telephone Company, resigned his position to take effect October 18th. His successor has not yet been named.

G. A. Turpin has resigned the management of the Sebree Independent Telephone Company at Sebree, Ky., and will assume a similar position at Henderson. His successor has not yet been named.

J. Wagener of the electrical engineering staff of the Stromberg-Carlson Telephone Manufacturing Company, Chicago, is at Bridgeport, W. Va., on business for his firm with the Belmont Telephone Company.

William E. Hawkins has severed his relations with the Missouri and Kansas Telephone Company to accept the position of general superintendent of construction with the Consolidated Telephone Company, Buffalo, N. Y.

Jos. Driscoll, who has been connected with the People's Telephone Company of Duluth for some time, has been called to Colquet, where he will assume the management for the Northland Telephone Company. The Northland Company operates exchanges at Carlton, Thompson and Scanlon.

James F. Carbin of Bloomville, accompanied by K. F. Briggs, secretary and Edwin R. Strohm superintendent of the Home Telephone Company, Tiffin, Ohio, visited Chicago's big Independent telephone plants last month.

R. Nelson, formerly of Appleton, Wis., has assumed the management of the Oconto exchange, succeeding C. H. Bau. Mr. Bau will move to Manitowoc, where he will have charge of the inspection department for the company.

John Allen Haines of the firm of Haines & Noys, Chicago, was married October 22, to Miss Edith Key, 85 Rush street, Chicago. Mr. and Mrs. Haines left immediately after the ceremony for an extended trip through the east.

C. P. Platt of the sales department of the Kellogg Switchboard and Supply Company, Chicago, is still confined to his home with typhoid fever. The patient, enjoying a very wide acquaintance in the telephone field, has many friends who are hopeful for his early recovery.

Henry L. Shippy of the John A. Roebling's Sons' Company, New York office, has returned from an extended visit to London. It is claimed that Mr. Shippy is one of the greatest travelers in the telephone field. At London he attended the coronation of King Edward.

I. A. Lumpkin, vice-president of the Interstate Telephone Association, visited in Chicago about the middle of October on business connected with the association's affairs, returning to his home at Mattoon, Ill., after it was determined to hold the next meeting at the Auditorium Hotel, December 9, 10 and 11.

H. D. Cheever, accompanied by his wife, has recently returned from an extended hunting expedition in northern Maine. Mr. Cheever is manager for the Okonite Company, Ltd., New York City. Both Mr. and Mrs. Cheever were successful in bagging magnificent specimens of moose during their pilgrimage.

Frank Knickerbocker of Danville, Ill., has been succeeded by N. C. Griffith of Hamilton, Ohio, as superintendent of the Home Telephone Company, engaged in construction work at Peru, Ind. Mr. Griffith has had more than twenty years' experience in construction work and is well qualified for the position he has assumed.

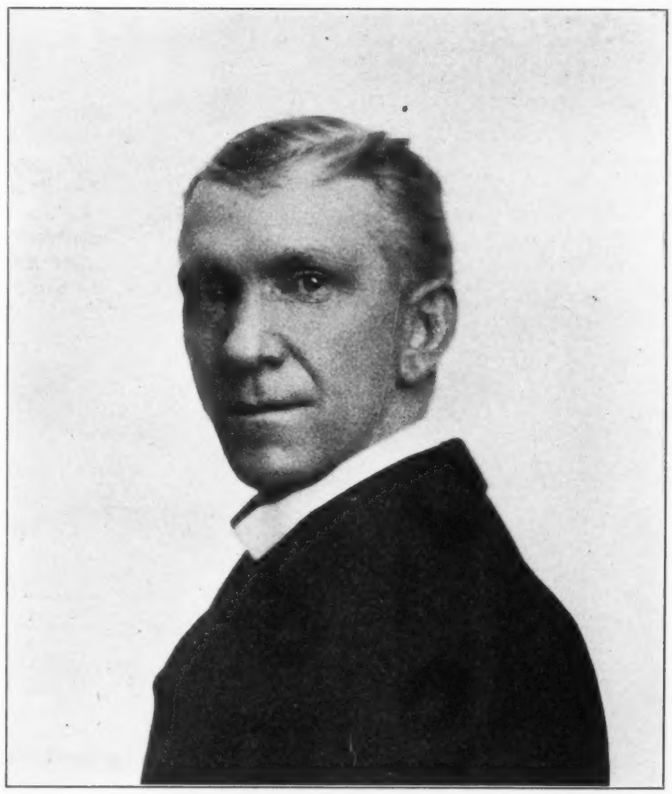
W. A. Douglas, a well-known Buffalo attorney and formerly a member of the State Tenement House Commission, has been appointed general manager for the Frontier Telephone Company. Mr. Douglas is noted for his great business ability and executive capacity, and will no doubt make a splendid manager for his employers.

Carl P. Fiel, of the Telephone and Switchboard Workers' Union, Chicago, has distinguished himself by writing a spectacular play which he calls "Humanity." The play deals with unionism and by allegorical characters demonstrates how its enemies should be punished. The author also gives his remedy for the trust evil. The first performance of the play was given in the North Side Turner Hall, Chicago, Saturday, October 11th, for the benefit of the sick fund of the Telephone and Switchboard Workers' Union No. 1.

Jas. E. Keelyn, known as the "father of Independent telephony," has assumed charge of the sales department of the new Western Telephone Manufacturing Company, Winthrop Harbor, Ill. This company is the successor of the pioneer Western Telephone Construction Company, of which Mr. Keelyn was president for many years. It is reliably stated that the new Western Telephone Manufacturing Company is composed of several of Chicago's wealthy citizens and gives promise of becoming a great manufacturing institution.

Well-known Heads of Well-known Houses.

Frank B. Cook, whose portrait appears herewith, is one of the best known men in the telephone field. He was born at Monroe, Michigan, in 1855, and began his telephone career in Toledo, Ohio, in 1878. Previous to this he devoted a few years to telegraph construction work, but the foundation of his success was due to the fact that he was a practical and skilled mechanic, and after his telegraph experience he entered the field which was destined to make his reputation, and in which he has been singularly successful. He is not a graduate of any college, his experience of electricity was gained through his own hard work and experiments. When Mr. Cook entered telephone work there were no magazines or other books devoted to telephony. So he was forced to acquire his knowledge through other sources. In those early days of the business much of the apparatus was crude and improperly designed, so he had ample opportunity to employ the inventive genius which he possessed. The list of his inventions is a long one, and some of his patents have become known throughout the civilized world.



FRANK B. COOK.

Mr. Cook's first telephone position was with the Bell Company in Toledo, with whom he remained but a short time, as the Edison Telephone Company, who was preparing to enter the field in competition with the Bell company, secured his services as superintendent of installation. The Edison company was in reality a concern owned by the Western Union Telegraph Company, and the competition was nearly as keen between the two companies then, as it is to-day between the Independents and Bell. In 1880, when the Bell absorbed the Western Union's telephone business, the nucleus was formed of what has commonly been called the "Bell monopoly." The history of the rise and fall of this once powerful factor in telephone development is of too common knowledge to require any further mention. In his chosen work Mr. Cook's advancement was rapid, with the scope of his work constantly broadening. The knowledge and skill he displayed in the installation of one of the first multiple switchboards installed at Toledo made his services valuable, and his services were secured for the installation of similar switchboards in Columbus. In this work he made many improvements in the existing apparatus, and about this time he made application for a patent on the cross connecting, or distributing board, which patent was sold to the Bell company for $1,000. He also, at this time, in partnership with his brother, James A. Cook, invented the system of wiring multiple jacks in sections, which system is now used by all multiple switchboard manufacturers. During the construction of the Toledo plant he had charge of the installation of plants at Toledo, Ohio, Peoria, Illinois, and Des Moines and Davenport, Iowa, besides several smaller places.

In 1887, as the Columbus plant was nearing competition, the three thousand line exchange at Pittsburg was partly destroyed by fire. The multiple boards were found in such condition that it was found necessary to entirely dismount, rebuild and rewire them. Mr. Cook was given full charge of the work of reconstructing the exchange. This work was entirely finished within thirty days, which was a remarkable achievement at that time, and the vice-president of the company complimented Mr. Cook in a very substantial manner, and advised him to take out patents on the new wiring system, which patents were shortly afterwards granted. About this time the Western Electric Company, the Bell manufacturing concern, sent its experts to investigate Mr. Cook's work and offered to buy his switchboard wiring patents. A deal was consummated and patent 385,846 was issued, July 10, 1888, to the Western Electric Company.

In the spring of 1888 the Chicago Telephone Company was about to move its main office into its new building and install a multiple switchboard of 5,000 subscribers, and Mr. Cook was selected to take charge of the work. This installation was completed within three months. Shortly after this Mr. Cook was offered the position of chief engineer of the Central Union Telephone Company, then operating some two hundred exchanges in the states of Ohio, Indiana, Illinois and Iowa, being the largest sublicensee of the parent Bell company. In this position he developed a remarkable talent for handling the work entrusted to him and new duties were constantly laid upon him until he had full charge of all the company's construction and underground work throughout the four states, as well as the installation of all equipment, including switchboards and all other apparatus.

When the Independent telephone movement gathered headway in 1894 and 1895, Mr. Cook considered the advisability of leaving the Bell service, and entering the Independent field as a manufacturer of telephone apparatus. In 1896 he severed his connection with the Bell company and in the year following started a small factory in Chicago. Business rapidly grew, the first large order being for a complete protective system for the Kinloch Telephone Company's eight thousand line exchange, also a complete system for the Des Moines (Iowa) Mutual Telephone Company and the Valley Telephone Company of Saginaw, Michigan.

In February, 1898, the Sterling Electric Company of Chicago was organized and took over the business. In 1899 this company moved to Lafayette, Indiana, and was incorporated under the laws of the state of Indiana, of which company Mr. Cook was the president and controlling factor until February, 1902, when he sold his holdings in the company, and after a few months' rest started his own manufacturing plant in Chicago.

Telephony.

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THE INTERSTATE CONVENTION.

The annual meeting of the Interstate Independent Telephone Association will be held at Chicago, December 9, 10 and 11. The committee of arrangements has selected the Auditorium Hotel as convention headquarters and has secured special hotel rates for convention delegates. Reduced fares will also be granted by all railroads.

The Sherman House convention of this association, held in Chicago in April, will undoubtedly be surpassed both in attendance and importance. The manufacturers, jobbers, etc., of Chicago and vicinity are contributing to an entertainment fund, which is already larger than any fund ever raised for a telephone convention. It is expected that from $5,000 to $6,000 will be expended by the entertainment committee during the three days of the convention. A number of enjoyable features are under consideration, but the final details have not yet been fixed. One of the principal events on the program will be a banquet to be held in the Auditorium. Preparations will be made to seat over 1,000 guests.

The total attendance at the convention will probably be in excess of 1,000, and in every way the convention will be the most representative gathering of Independent telephone men ever held in the United States.

The executive committee of the association has arranged the program of the convention sessions in such a manner as to secure practical papers on matters vitally interesting to Independents. The meeting is designed to be a clearing house of Independent ideas in the Interstate territory, and the fullest opportunity will be given for discussion on all the subjects which are to come before the convention.

The future of the Interstate Independent Telephone Association is bright with prospects for good. It is a thoroughly Independent, vigorous, energetic association, but it is not yet what it will be later on. Every Independent company in the territory of the association should have a representative at the convention. Independents should be acquainted with each other and with each other's needs and plans; conventions are the meeting places for ideas. Independents should be friends, yes, even brothers; conventions are the home-comings of all the big Independent family.

Let every Independent who can get to Chicago be present at the convention December 9, 10 and 11. Remember the dates and plan your affairs so that you can come. It will do you good to lay business aside for a few days and devote yourself to helping the great Independent movement onward. You will be given the best time you ever had at a convention. Everybody will do his best to make you at home. You will see all the latest apparatus and will go home with a harvest of new ideas for your own exchange.

THE TELEPHONE AS A GERM BREEDER.

We do not desire to have it generally understood that the present agitation in the matter of medicating the telephone transmitter is a new one or that it emanates directly or originally from TELEPHONY. What we do wish to impress upon the manufacturers, retailers and users of the telephone is that the time has certainly arrived for some specific action on the question of sterilizing the mouthpiece, and the sooner it is done the better. There is no question whatever that the telephone mouthpiece, like anything else coming into intimate contact with the breath and sputum of a cosmopolitan class of people, both healthy and unhealthy, clean and unclean, must of necessity be a means of infection unless it is thoroughly cleaned at short intervals like any other receptacle used in a similar way.

Boards of health, physicians and bacteriologists all over the United States have made repeated attacks upon the transmitter as a means of direct infection among those using these instruments, and there is no doubt that an abundance of evidence bearing upon this fact can be had from the medical profession if they cared to give it out for publication. The profession, though, always an ultra-conservative body, will seldom undertake to make public matters of great importance until such time as the question becomes absolutely serious, then it goes at it with "hammer and tongs."

There have been any number of devices patented for the purpose during the last ten years. There have been numer-

ous antiseptic washes put up and sold for the purpose. But the great trouble with all these things has been to get the people to use them. This has especially been the trouble with washes. People cannot be forced to do these things, and we doubt very much whether any body politic anywhere in the United States would undertake to tell us that we must buy this or that "to do the trick." It may be that boards of health may be able to issue an ordinance compelling the telephone companies to clean their public telephones operated by themselves, but this would only be a short way on the long road to do away with a matter now considered of serious moment. Washes have been tried with hardly fair results, but people will not use chemicals that have much smell, and almost anything of a volatile nature rubbed on the telephone mouthpiece leaves an odor not at all agreeable to the great majority of users. Again, we have it from reliable medical authority, washes, according to the bacteriologist's standpoint, are not a reliable method for the purposes claimed unless the mouthpiece is cleaned every time after it is used. This seems to us a good measure of common sense; the transmitter is practically a non-porous, hard-surfaced composition, a wash can only become thoroughly reliable or efficient so long as the antiseptic lasts.

As aforesaid, many antiseptic solutions have been put up to wash the telephone mouthpiece. They are pronounced unreliable and have, in a measure, been condemned by the bacteriologist. The wash dries almost immediately on the hard surface and any person afflicted with disease can deposit bacteria thereon and infect the subsequent user. We understand there is abundant evidence to be had of this fact, numerous tests having been made with all known reliable antiseptics on many public telephones less than ten minutes after they had been washed, and the various known dangerous bacteria have been found to thrive abundantly. This can be personally demonstrated by any chemist in his own laboratory by washing his telephone with a strong bichloride of mercury solution and testing it a little later on with such well-known bacteria as staphylococcus pyogenes aureus, from cases of suppuration in human beings, or bacillus diphtheria, using any virulent and constant culture available. We only suggest these things in the interest of the business if the question is to become one of general agitation all over the country. It appears, therefore, that the only way a wash can be used with any degree of certainty is to use it each time the person uses the telephone. This seems to us not only expensive, but an unpleasant task to most people.

Washes emit an odor not always pleasant to the user and are more or less irritating to any sensitive throat. Again, the only germicides that would kill bacteria in a dry state (assuming, of course, that one claims washing effective only at rare intervals) are irrespirable gases. It would be out of the question to use such substances; first, because they could not be confined to the mouthpiece, and second, because, unless so confined, they would be irritating to the throat of any user.

If we are to cope with the question at all let us go at it in a safe and thoroughly scientific way and not jump at it blindly.

PROFITABLE RATES AND MARKETABLE SECURITIES.

How can the Interstate Independent Telephone Association best serve the Independent interests at the coming Chicago convention? is a question many telephone managers are turning over and scanning from every point of view. Many members believe that the association should concentrate all its efforts and bring all its influence to bear along two lines; namely, first, in effecting a general increase in Independent telephone rates all over the country, and, second, in placing Independent securities on a permanent and stable basis that will lead to their being readily accepted by the investing public.

Now it goes without saying that if the income per station can be materially increased and the interest and other fixed charges somewhat reduced, repairs and renewals and even betterments can be paid for out of the net income and yet leave ample surplus available for reasonable dividends on the outstanding stock. Then, once this improved condition of affairs is established, it will be comparatively easy to place securities for all needed extensions and extraordinary improvements, and thus secure the funds needed to place the plant in an up-to-date physical condition that will enable its directors to fight the Bell on more even terms. And the increased income assured by the increase in rates will justify the increase in permanent liability.

Every thoughtful member of the association who has given the subject the consideration it merits, admits that the dollar residence rate is a delusion and a snare, *that the people never demanded it,* but it was securely strapped on to the Independent movement through the machinations of certain construction men and members of the Hot Air Brigade who did not hesitate to take advantage of the inexperience of new comers in the Independent field. The continuance of the dollar rate means not only the impoverishment of one-half the Independent companies, but the ultimate loss of confidence in Independent securities. For the future of the movement is dependent entirely on the confidence the public has in Independent securities, and that confidence will be largely influenced by the strength shown in the financial statements of the weakest link in the chain—the exchanges supplying residence service at a dollar a month.

Therefore, in the opinion of many, the association can best serve the interests of its members by wisely and fully discussing the advisability of placing on record in a form that can be used by the members in asking their respective local authorities for an increase in rates, the fact that hundreds of Independent exchanges are supplying telephone service at less than cost; that to continue so doing is certain to lead to bankruptcy; that if the Independents go bankrupt the monopoly will raise its rates regardless of the protests of the people, that the people are willing to have the $12 rate raised to $18, and the $18 rate raised to $24, for even these increased rates are but one-half what the Bell formerly charged for service of less value; and that through the efforts of the Independents thousands of homes now enjoy the comforts, the conveniences and the safety incident to the telephone that probably would never have known its value under the reign of the old monopoly.

GOLDEN OPPORTUNITIES FOR EARNEST WORKERS.

Occasionally the remark is heard that "the telephone field presents few opportunities to the ambitious young man and none to the ambitious young woman." Again, a general impression prevails among the uninitiated that possibilities of promotion end in local management of small exchanges. Both conclusions are grave mistakes. For few lines of industry present such excellent opportunities for rapid and successive promotion to the progressively earnest, thoughtful and industrious. And, best of all, there is a fascination enveloping the marvellously rapid and ever-increasing growth of telephony, with its simple yet seemingly intricate and constantly improving mechanism, that serves to stimulate the worker to higher and nobler achievements, and to instill the thought that the allotted portion is part of a world's work that will embrace not only a continental system of telephone circuits and exchanges, but telephone lines uniting continents, and bringing all civilized nations within speaking distance. Thus, in its many-sided and ever-

changing phases and its ever-increasing magnitude there can be no possibility of routine work or monotonous dullness to the earnest worker in the telephone field. The manager of the small local exchange may feel that the entire field is thoroughly worked over, and the plums all picked. But the changing local conditions, the ever-widening field and the corresponding increase in scope and comprehensiveness of service, as well as the changing character of all telephone service, must continue to bring to view what may be aptly termed virgin soil, the proper and thorough cultivation of which is certain to yield rich recompense.

While golden opportunities are open in the operating, the mechanical, the engineering and the executive branches of the telephone industry from the operating standpoint, ample scope for the brightest talents will also be found in the manufacturing, contracting and constructing branches. For the young men and women who do their own thinking, and maintain a receptive attitude, who are quick to conceive, keen to perceive, prompt to plan and practical in execution, the field is open wide. For there is a constant demand for those who are not content with mediocre merit, but rest not until assured success crown their efforts in all that is worthy to be striven for; those who in an open contest make their opponent taste the bitterness of defeat.

The telephone industry is less than a quarter of a century old. In a crude form the telephone was shown at the Centennial in 1876. A year later there was a small demand for "Bell's toy" for private line telephone service. In February, 1878, the first telephone exchange in the world was opened in New Haven, Connecticut. Five years later, that is, at the close of 1882, there were 725 Bell exchanges and 345 branch offices supplying service to 97,728 telephone stations. In this work 3,716 employes were required, or an average of one employe to every 26 stations in service.

Nineteen years thereafter, that is, on December 31, 1901, the number of Bell exchanges had increased to 1,411, the number of branch offices to 1,594, the number of telephone stations to 1,020,647, and 40,864 employes were required to care for this Bell service only. That is, there was an average of one employe to every twenty-five Bell stations in service throughout the country, including villages and cities.

Now during the past four years the net yearly increase in Bell telephone stations has exceeded 25 per cent per annum, and there has been a corresponding net gain in the number of Bell employes. That is, on December 31, 1898, there were 19,668 employes, and on December 31, 1901, 40,864; a net gain of 21,196 employes, or of 108 per cent in four years.

As the Bell company is introducing its measured service rates in every city and rapidly doing away with the flat rate, thereby encouraging an enormous increase in the use of the telephone and insuring its installation in thousands of homes and offices that never before enjoyed the comfort and conveniences of a telephone, it is safe to assume that the number of Bell telephone stations will be again doubled four years hence; that is, there will be more than two million telephones in service on December 31, 1905. And as there must be a corresponding increase in the number of employes, it is reasonable to suppose that the number of Bell employes will then exceed 80,000.

In other words, there is every reason to believe that there will be 10,000 new openings in the Bell service only each year during the next four years. That is 10,000 new positions for bright young men and ambitious, thoughtful young women, to say nothing of the changes in the existing Bell forces. Think of it! Ten solid regiments containing a thousand persons each, will be added each year during the next four years, to the army of Bell employes only.

And that is but one phase of the golden possibilities in the telephone industry, and is merely presented here first simply because accurate data covering the Bell annual growth and operations during the past twenty years is available to all who are interested in the subject. There is only one Bell company, with about forty large licensee companies that may all be merged into the parent company some day (and speed that day in the interest of good service). But there are more than a thousand Independent telephone companies operating probably as many exchanges and branch offices and stations as the Bell company. Mr. T. C. Martin claims that the Independents "by 1900-1901 had attained a total of about 2,750 exchanges, with 700,000 subscribers, and an investment of $150,000,000," while Mr. A. V. Abbott claims for the Independents a similar investment of $150,000,000, but records 2,811 exchanges and 1,198,000 telephones. Then in the July mailing list of telephone buyers issued each quarter by TELEPHONY there are 4,758 Independent exchanges listed. While the card catalogue of the North Electric Company, of Cleveland, shows a total of 4,446 Independent exchanges. Adding these four sums of 2,750, 2,811, 4,758 and 4,446 together and dividing by 4, gives an average of 3,691. Thus it is safe to assume that there are 3,700 operating Independent exchanges supplying telephone service in the United States. The number of Independent telephones in use can only be approximated as Independents have never supplied any complete and accurate data, failing to perceive how valuable in the placing of telephone securities accurate and comprehensive data is. But from data accessible to the editor of TELEPHONY, compared with other data, a careful estimate shows that the Independents should have at least 1,350,000 telephones in service, or as many as the Bell has.

While it is well known that the Independents do not have as many employes relatively as the Bell, yet it will be fair to allot one to each thirty-five Independent stations in service, as the character of the construction adopted by some of the Independents soon necessitates a larger maintenance force than the Bell carries for a similar number of subscribers. On the basis of 1,350,000, this would mean a total of 38,572 employes in service at the present time. If the Independent growth continues on the basis of an average of 25 per cent per annum, and, by reason of the extremely low and, in many cases, unprofitable rates, it is more than likely to exceed 35 per cent per annum, then there will be a demand from the Independent telephone companies for an average of 9,643 new employes each year, or nearly as many as the Bell will require.

Thus these two phases only of the operating branch of the Independent telephone industry probably employed no less than 79,436 persons at the beginning of 1902, and will require nearly 20,000 additional assistants each year during the next four. But this operating branch also requires an additional force indirectly though the demand for expert telephone operators for private branch exchanges now utilized in all the larger offices, mills, factories, banks and business houses; a system that affords a rapid and effective method of handling all the telephone traffic incoming to or originating within the respective establishment.

In the larger cities these private branch exchanges are very numerous. There are probably 2,500 in service in New York City, each requiring the service of at least one operator and many employing two or more operators. Hence, it is reasonable to assume that there are not less than 15,000 private branch operators in the United States. Added to our previous total of 79,436 this would give a grand total of 94,436 persons employed in the operating branch of the telephone industry. Incidentally it may be added that these private branch operators are not in the employ of the telephone company, either Independent or Bell, but are in the employ of the firm or company having the private branch exchange and thus do not appear on the list of telephone employes or on the pay roll of the telephone company. But as the position of branch telephone opera-

tor is considered a very desirable one, it is usually filled by selecting one of the expert operators from the force at the local exchange.

Facing a total of 94,436 persons in one branch of a new industry growing at a marvelous pace, is it possible that any one can be so dull of comprehension as to not perceive how many and how excellent are the possibilities of promotion? Here are ninety-three regiments containing 1,000 persons each. Must there not be major as well as minor positions? And with more than 20 new regiments added each year, are these not golden opportunities for advancement?

There is a constant demand for first-class general managers, general superintendents, district managers and local managers, as well as for superintendents of construction, of equipment and of maintenance, and each and all can command all that their services are worth. Then the demand for first-class traffic managers is greater than can be supplied for several years, for a satisfactory traffic manager is the product of years of service, and of a year's comprehensive study of the problems involved in the transmission of conversational traffic combined with exceptional ability and an enthusiastic desire to make telephone service what it should be, to instill into the operator a love for the wonderful work she is engaged in, to lead the telephone user to perceive how greatly his own interests will be advanced by hearty and intelligent co-operation in expediting and improving the service. A dozen first-class traffic managers are needed to-day, and could be placed at once at salaries ranging from $2,000 to $3,000 a year. Competent chief operators are in demand; not the ordinary kind, but the chief operator who understands the duties of and the limitations of an operator and knowing this can teach it to the operator in a manner that will awaken a desire in the operator to learn more and to excel in all she undertakes. Such chief operators are soon promoted to be assistants to the traffic manager and are worth their weight in gold for maintaining that unity of action, generous co-operation and loyalty to the company's higher interests among the operators that results in a service satisfactory in every sense to the user.

PROFIT-PRODUCING TELEPHONES.

In his charming sketch, "The Telephone Door," Mr. A. S. Hibbard clearly portrays how the telephone receiver is an actual doorway through which a greater amount of business traffic may enter than comes in through the doorways planned by the architect; how it is just as unprofitable to allow outgoing calls to block this entrance as it would be to block the main doorway with outgoing shipments, and thus prevent customers from entering; that to allow clerks to merely gossip with the aid of the telephone is often equivalent to allowing these clerks to stand and gossip in the main doorway and block that entrance so that no customer can possibly enter; in other words, shutting out all customers until the gossipers have ceased their trivial conversation.

It is further shown in the sketch how many merchants do cultivate the habit on the part of their customers of entering through the telephone door, thereby saving the customer time and travel; and, in order to facilitate this incoming of satisfactory and profitable business, these merchants endeavor to have the telephone door closed as seldom as possible by outgoing messages.

Until this point is clearly explained to them, few clerks realize how easily their action of sending a series of outgoing telephone messages, one after the other, may as effectually drive profitable customers away from their employer as though the main doorway had been locked during the fifteen or twenty minutes in which the clerk was so telephoning.

Progressive business men have also learned that the cost of telephone service is a minor factor considered with the far greater and more essential factors of quality and comprehensive scope of telephone service. The cost will take care of itself in the increased business that it usually brings to the business house, or in the conveniences and comforts that the telephone brings to the housewife, and the assurance of safety and protection that follows the knowledge of the ability to instantly communicate with police or fire department at any hour of day or night. And this question of the cost taking care of itself is especially true in all cities where the measured-service system is employed—that is, where you pay only in proportion to the number of calls that you desire to make.

But the quality of service is dependent entirely on unlimited capital, broad and skillful engineering talent, and a true comprehension of the needs of the public that years of ever-widening experience alone can give.

A number of towns in Great Britain have gone into the municipal telephone business in competition with stock companies. The municipal corporations usually offer service at greatly reduced rates, and this fact is generally overlooked in making a comparison of the earnings with the invested capital. For instance, Glasgow's undertaking in this line only showed a profit of $2,170 during its first year of operation, upon a revenue of $190,000, but the subscribers were benefited to the extent of $105,000, representing the difference between municipal and the National Company's rates. Manchester is now conducting investigations with a view to opening a municipal exchange. At Tunbridge Wells, the first year's working showed a moderate profit. At Glasgow, there are 7,000 subscribers to the municipal system in comparison with 8,000 subscribers on the privately owned exchange. Fully forty per cent of the subscribers to the municipal exchange also have telephones on the National circuit.

Ray Stannard Baker, in the *Outlook*, says: The Turk suspects everybody and everything, and no private act, no seclusion is safe from his intrusion. Every telegram sent from the public offices is at once reported to the authorities. For the reason that the authorities cannot be sure of a complete knowledge of all the conversation that might pass, the telephone has been excluded from the empire; and no Turkish city is electrically lighted because, it is said, the officials discovered the word dynamo in the applications for the necessary contracts, and, dynamo suggesting dynamite, the official Turk was paralyzed with fear!

The fourth annual meeting of the Kentucky Independent Telephone Association was held in Louisville October 28 and 29. A great many representatives of the various Independent telephone companies throughout the state attended. The Home Telephone Company entertained the delegates and an attractive program afforded a portion of the entertainment. Among the companies represented were the Louisville Home, Fayette Home, Independent Long Distance, the Bastian of Lancaster, Kentucky and Indiana of Owensboro and Rough River of Ohio county.

The climate of Egypt is so hot and dry that good timber to use for a pole line for the transmission of an electrical current does not grow and timber imported from other countries dry rots and becomes useless in a short time. A certain pole imported from Sweden has proved to be the most valuable, but its greatest life was not over four years. Michigan grown white cedar posts are now being shipped to Cairo, Egypt, to test their lasting qualities in a climate so fraught with difficulties to telephonic transmission.

Manufacturing Plant of Frank B. Cook.

In the illustration below is shown the manufacturing plant of Frank B. Cook, 240-255 West Lake street, Chicago, and in the illustrations on the pages following is shown the offices and some factory views.

The factory is now in full operation and is turning out large contracts for prominent Independent telephone companies. Among the protective apparatus manufactured might be mentioned:

Cook tubular line fuse. Patented October 21, 1902. Other patents pending.

Cook tubular fuse for strip mounts. Patented October 21, 1902. Other patents pending.

Cook tubular line fuse for terminal mounts. Patented October 21, 1902.

Cook horizontal tubular line fuse. Patented October 21, 1902. Other patents pending.

Cook tubular line fuse for No. 12 protector. Patented.

Cook tubular line fuses mounted on strips. Any number of pairs. Patented October 21, 1902.

Cook tubular line fuse combined with carbon plate lightning arrester mounted on strips. Any number of pairs. Patented May 20, 1890; October 21, 1902.

Cook tubular line fuse combined with carbon plate lightning arresters mounted on iron strips. Any number of pairs. Patented May 20, 1890; October 21, 1902.

Cook mica fuse and carbon arrester mounted on iron strips. All sizes, 10 to 100 pairs.

Cook combined cable terminal and protectors with heat coil and carbon plate arresters for strong and sneak currents. Patented May 20, 1890; July 8, 1902; August 12, 1902; August 12, 1902. All sizes, 25 to 200 pairs.

Cook combined terminal and protectors, mounted on metal strips with heat coil and carbon plate arresters for strong and sneak currents. Patented May 20, 1890; July 8, 1902; August 12, 1902; August 12, 1902.

Cook main distributing board, iron frame, with strong and sneak current protectors. Patented May 20, 1890; July 8, 1902; August 12, 1902; August 12, 1902. Other patents pending. All sizes. Any capacity.

Cook pole top cable terminal. Patented June 16, 1900. All sizes, 15 to 100 pairs.

Cook pole cable terminal with line fuse and carbon plate arrester. Patented May 20, 1890, October 21, 1902. Other patents pending. All sizes, 25 to 100 pairs.

Cook lock nut terminal with mica fuse and carbon plate arresters. Patented May 20, 1890. All sizes, 10 to 100 pairs.

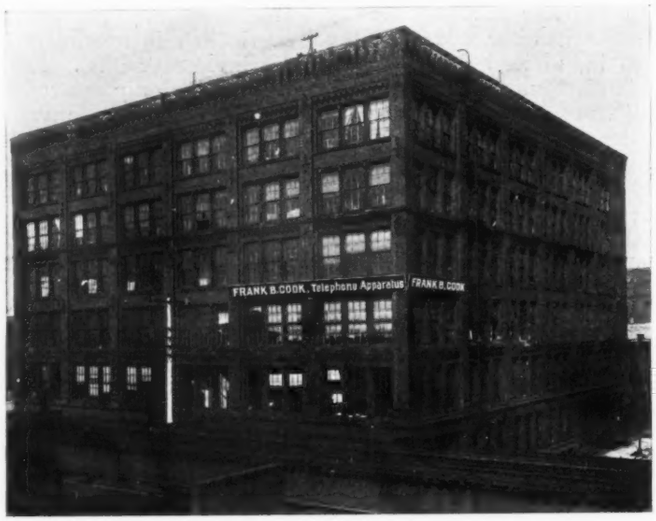
Cook cable terminal with tubular fuse protection. Patented October 21, 1902. All sizes, 25 to 100 pairs.

Cook cable terminal with mica fuse protection. All sizes, 25 to 100 pairs.

Cook connecting and multiple distributing strip for buildings or pole houses. Any number of pairs.

Cook lock nut cable terminal. All sizes, 10 to 100 pairs.

Cook heat coil protectors. Any resistance for magneto or common battery circuits. Patented July 8, 1902.



FACTORY FRANK B. COOK, CHICAGO.

Cook subscribers' station protector. Patented May 20, 1890, July 8, 1902, August 12, 1902.

Cook toll line carbon plate arresters. Patented May 20, 1890.

Cook carbon plate and mica fuse arrester. Patented May 20, 1890.

Cook strong current protector, double carbon. Patented May 20, 1891. Other patents pending.

Cook No. 12 strong and sneak current protector for subscribers' station, with carbon plate heat coil and tubular line fuse. Patented May 20, 1890, July 8, 1902, August 12, 1902, October 21, 1902. Other patents pending.

Cook test connector for either copper or galvanized wire, any gauge.

Cook improved guy clamp, guaranteed not to slip.

Cook test plug for terminals.

Cook pole house for pot-head or terminal. All sizes.

Cook copper-covered pole side cable terminal. All sizes, 10 to 50 pairs.

Cook connecting and distributing strip for buildings or pole houses. Any number of pairs.

Cook sectional disc board. All sizes, 100 to 2,000 pairs' capacity. Patented October 15, 1901.

Cook terminal blocks.

Cook individual subscribers' station protectors with line fuse and carbon.

Cook pole house with terminals.

The above apparatus is claimed by the manufacturer to be standard and are in use by hundreds of Independent and Bell exchanges in the United States, while a great deal has been shipped to foreign countries, and in all cases has been uniformly successful.

Detailed description and prices will be gladly furnished upon request and the manufacturer invites correspondence on anything pertaining to protective devices for telephone properties.

The Cook apparatus is the result of a life study and is claimed to embody all necessary features to insure absolute protection for all classes of telephone apparatus and under all conditions.

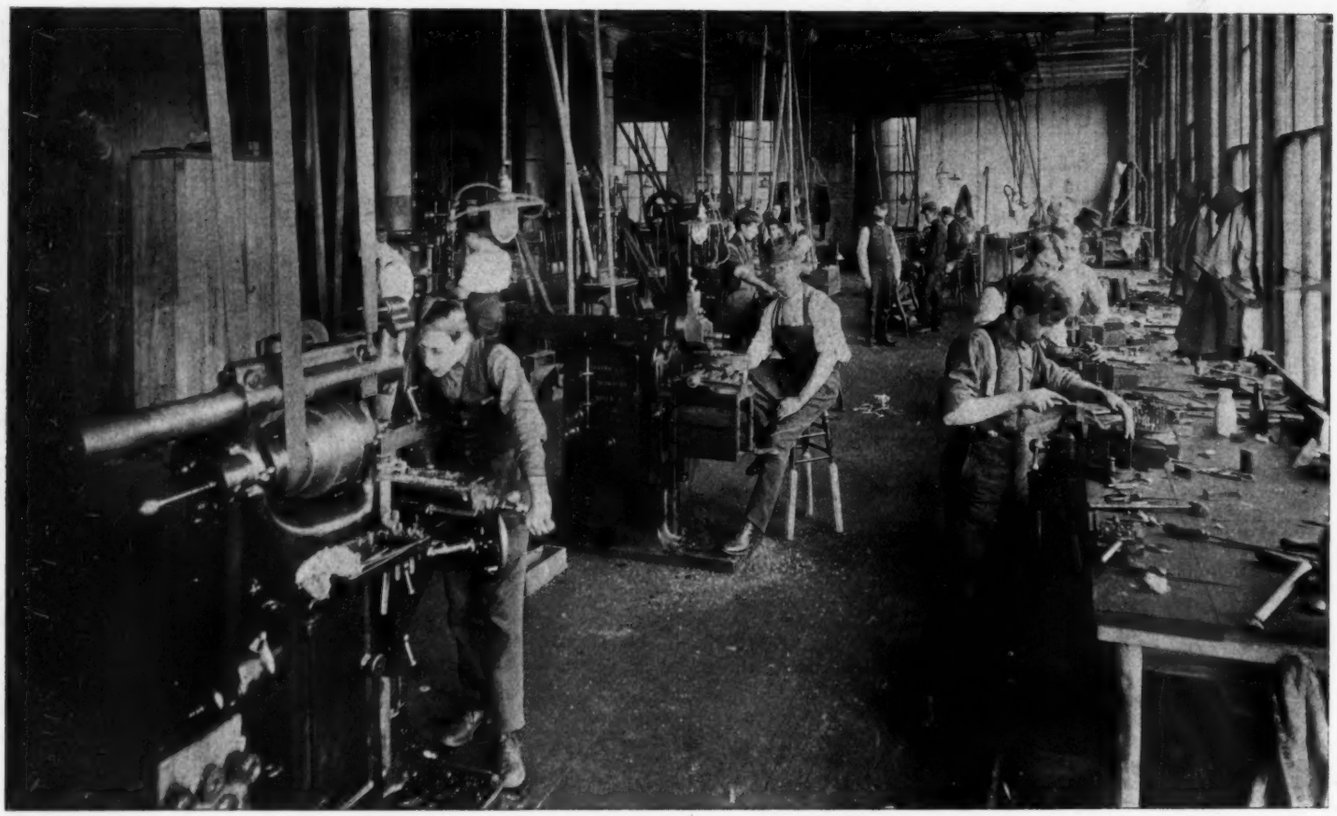
The Cook protective apparatus is sold under a broad guarantee, giving protection to every user.

The facilities for manufacturing the apparatus are of the very best, every known means having been employed to secure perfection of design and absolute reliability in mechanical construction. The factory space being light and commodious, affords opportunities for factory arrangements not ordinarily enjoyed by city manufacturers. It has been the idea of Mr. Cook, based upon his long practical manufacturing experience, that systematic attention to details best ensures mechanical perfection in actual construction. Acting on this idea the factory of Frank B. Cook will without question be one of the best arranged and most perfectly systematized manufacturing plants in Chicago.

All of the machinery installed is of the latest modern design, no expense having been spared in preparing for the business of the company, and all orders will receive prompt and careful attention.

OFFICE OF FRANK B. COOK, CHICAGO.

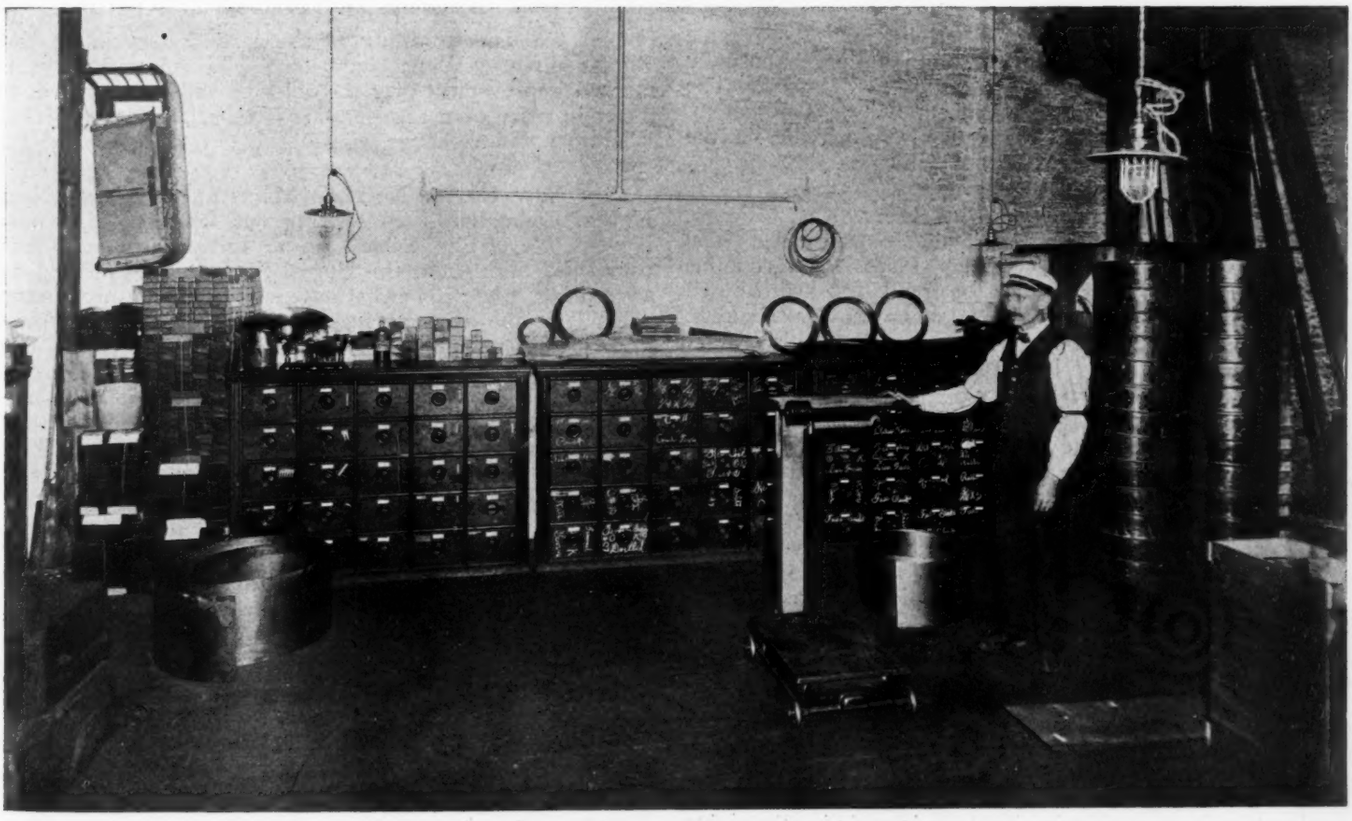
GENERAL OFFICES, FRANK B. COOK, CHICAGO.



MACHINE DEPARTMENT, FRANK B. COOK, CHICAGO.

FUSE DEPARTMENT AND SHOP VIEW, FRANK B. COOK, CHICAGO.

TERMINAL ASSEMBLY ROOM, FRANK B. COOK, CHICAGO.



STOCK ROOM, FRANK B. COOK, CHICAGO.

TRADE NOTES

THE CENTRAL TELEPHONE AND ELECTRIC COMPANY, St. Louis, has established an office in Chicago, located at 59 West Jackson Boulevard. The Chicago branch will be in charge of Mr. C. E. White, who will carry a full line of samples and be in a position to take care of any prospective customers for either instruments or appliances.

THE EUREKA ELECTRIC COMPANY, Chicago, has recently issued a handsome colored folder illustrating in natural colors some of its late productions. The scheme is something of a novelty in telephone advertising literature and must be seen to be appreciated. The company will cheerfully mail a copy of this folder to those who may be interested.

THE ATWATER KENT MANUFACTURING WORKS, Philadelphia, Pa., manufacturers of the Monoplex telephone, has removed to 112 N. Sixth street, where it has double the floor space previously occupied. Among the advertising matter this company is sending to the trade is included a handsome face of the Gibson type, printed on white behind a dark card which frames the head.

The excellency of the Mesco Dry Cell is attested by the thousands now being manufactured and sold daily by the Manhattan Electrical Supply Company. It is claimed there is not a dry cell on the market so well and favorably known. Among the largest users in Illinois is the Central Union Telephone Company, which should recommend the cell to anyone wishing to purchase.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, is evidencing considerable activity in its cedar pole department, anticipating that the autumn months usually afford the best opportunity for disposing of stock. The company has yards located at Wilson, Beaver, Ontonagon, Twombly, Lathrop, Pine Village and Perronville, in the cedar country, and assures prompt deliveries.

THE KELLOGG SWITCHBOARD AND SUPPLY CO., Chicago, issued during the past month a small booklet entitled "The Express and Some of its Stopping Places." It contains fifty-one testimonials regarding the small type switchboard manufactured by this company, known as the Express. The book is made up of what others say about this switchboard and should prove interesting alike to those who are using it and to those who are not.

THE NORTH ELECTRIC COMPANY, Cleveland, is now located in a large five story building on St. Clair street. This building had been entirely remodeled according to specifications of the North Company and serves as its general offices and factory. The new building affords several times the floor space previously occupied by this firm and places it in position to better care for its rapidly increasing business.

JAS. S. BARRON & COMPANY, New York, are sole agents for the Harloe self-tying insulators; insulators especially recommended because of the rapidity with which they can be put up and also because of the great saving in not using tying wires in their insulation. It is claimed that they cost less than one-half to install as compared with the old style. The Harloe self-tying insulator is made in all weights and to accommodate all sizes of copper and iron wire for inside and outside line construction and are manufactured either of glass or porcelain.

THE DEVEAU TELEPHONE MANUFACTURING CO., 27 Rose St., New York, has issued the tenth edition of its catalogue containing one hundred and thirty-two pages of descriptive matter pertaining to its line of goods, profusely illustrated. The company is introducing from time to time new apparatus not shown in its catalogue and requests that requirements be submitted in order that printed matter may be furnished descriptive of customers' probable needs.

THE F. BISSELL CO., Toledo, Ohio, has issued its catalogue No. 101, which is devoted principally to cables and conduits for electric lighting and power, telephone and telegraph, aerial, underground and submarine uses. In addition to supplying the trade in general with apparatus of this class, the company maintains its own engineering department and is prepared to lay out and plan complete systems and to furnish users with such information and advice as occasion may require.

THE MOUNTAIN STATE ELECTRICAL COMPANY, Wheeling, W. Va., recently closed a contract with the Dayton Home Telephone Company for 1,600 Hall cable terminals. The cables are the same as those previously furnished by this company to the Federal Telephone Company, Pittsburg; the National Telephone Company, Wheeling, W. Va.; and the Belmont Telephone Company of Eastern Ohio. The Mountain State Electrical Company assures us that it will be in position to furnish illustrations of several of its various appliances in time to reproduce in our December number.

THE ILLINOIS ELECTRICAL SPECIALTY COMPANY, 170 East Madison St., Chicago, has supplied the trade with a pot of good things in the form of an advertising novelty. The card is suggestive of a native Dahomeyan attempting the cooking of an unfortunate missionary, but upon closer inspection reveals a circular easily removed by means of one of the flames, calling attention to the merits of the Illinois direct reading ohmmeter. This instrument is a marked improvement over the old type and uses a galvonometer in place of a receiver. It is especially designed for laboratory and exchange work.

THE NEW HAVEN NOVELTY MACHINE COMPANY, New Haven, Conn., has been sending out samples of its new Novelty Never-Slip Cable Clip to Independent telephone companies throughout the United States. This method of advertising, while somewhat expensive, ought to prove very valuable to the company inasmuch as it shows better than in any other manner exactly what the clip is worth. The iron parts of the device are galvanized, the strap being made of zinc. Its manufacturers claim that it is the most mechanical and strongest clip on the market and that the price is easily within the requirements of competition. This company is meeting with encouraging success with many of its products.

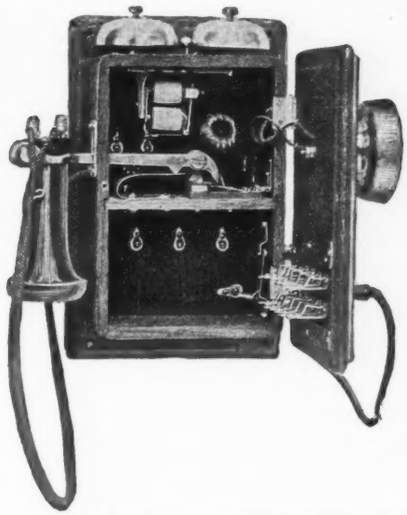
THE HAINES & NOYES CO., manufacturers of telephone apparatus, Chicago, has recently opened an Eastern office, under the management of J. A. Mears and F. H. Schlesinger, 220 Broadway, New York. This new office will take care of the entire Eastern business and all prices will be f. o. b. New York. A full line of stock and samples will be carried, and inasmuch as both Mr. Schlesinger and Mr. Mears are practical electrical men, as well as telephone men, The Haines & Noyes Co. feel sure that prospective purchasers and former customers will be well taken care of. Mr. Schlesinger was at one time asociated with Stanley & Patterson, and at an other time with the Peru Electric Mfg. Co. Mr. Mears is a well-known business man of New York

City. The Haines & Noyes Co. wish to state that all Eastern correspondence should be directed to the New York office.

H. L. CUTTER, president of the Telephone Hygienic Company, Los Angeles, Cal., was in Chicago recently endeavoring to interest capitalists in a telephone hygienic appliance which seems to cover all the requirements necessary in a device of this kind. This appliance consists of a small roll of antiseptic and chemically pure paper which rests immediately over the mouthpiece of a telephone, the paper being drawn tightly over the transmitter. This enables the speaker to talk against a clean surface, the sheet being torn away at the conclusion of each conversation. It is claimed that this appliance magnifies the sound of the voice and gives a more distinct message. It is easily adjusted to any instrument.

THE CENTRAL TELEPHONE AND ELECTRIC COMPANY, St. Louis, Mo., has issued a small booklet showing "Something New in Telephones for Interior Use." Battery call telephones for intercommunicating and hotel use is a line recently taken up by the Central Company, which has met with considerable success in St. Louis. The desirability of telephones for interior use now being generally recognized, a telephone instrument that is not only highly efficient

NO. 5—INTERCOMMUNICATING TELEPHONE CLOSED.



NO. 5—INTERCOMMUNICATING TELEPHONE OPEN.

NO. 6—WALL TELEPHONE.

but has the additional quality of durability claimed for the Central's new product, ought not to be overlooked in equipping any up-to-date business house. The company guarantees its line on the following points: Perfection in mechanical and electrical construction; no cross-talk, if properly installed; plugs can be left in any jack without disturbing the station by so doing, and less battery required than in any other system. Figures No. 5 and 6 show its No. 5 Wall Telephone closed and open. The illustration of Wall Telephone No. 6 is also shown. The working parts of these two instruments are very similar. The wood work of the telephone is dark antique oak, and adjustable arm transmitters are used. This combination makes a very handsome instrument to be in harmony with fine furnishings, either in large residences or business houses. This instrument is of the central energy intercommunicating battery-call type and no detail is overlooked in making each one perfect in its working parts; convenient to operate; easy to maintain; efficient and durable. The company is in position to make very attractive prices to dealers and are offering them to dealers generally. Points of merit are claimed for these telephones not included in other similar goods on the market.

THE STANDARD POLE & TIE COMPANY, No. 44 Broad street, New York city, deals in poles, ties and cross-arms—nothing else. For about nine years the business was conducted on a small scale by Mr. A. D. French. On the death of Mr. French, in May, 1900, the company was formed and the capital was greatly increased. Maxton, N. C., was chosen as the most suitable new location, it being the center of the best timber section of the state. Besides the round juniper poles it has manufactured and sold great quantities of octagonal pine poles. These are sawed from the best quality of long leaf yellow pine, dressed, painted, and the butts treated with one coat of dead oil of coal tar. It was decided to build and operate a large cross-arm mill of its own, and the best location for the mill found at Brooksville, Fla., in the very heart of the Florida heart pine belt. In connection with the cross-arm mill it will operate a fully equipped sawmill, in which it will saw its octagonal and square poles together with stock for its cross-arms. The cross-arm mill, which will be ready January 1, will have a capacity of two carloads of arms per day, and the timber will be of a quality to satisfy the most exacting. Samples of this Florida heart pine, as well as samples of the juniper, were on exhibition at the Annual Street Railway Convention.

The total valuation of all telephone companies in Tennessee, according to the returns furnished Secretary of State Webb, is $373,920, and the total tax paid to the state is $2,243.57. It is believed that there are a number of telephone companies which have not sent in their returns as required by law and the report as given out by Secretary Webb is not considered complete.

The state department at Washington has been informed by Consul Roosevelt at Brussels that an Anglo-Belgian telephone service will be inaugurated about the first of the year. The work of laying the cables has been completed at a cost of nearly $400,000, which will be shared equally by England and Belgium.

Now that you have bathed your telephone, what are you going to do with the microbes in your booth?

THE MONARCH GENERATOR.

In designing its generator shown in figure 1, the Monarch Telephone Manufacturing Company, Chicago, realized the growing demand for a machine that would successfully operate a large number of bridged magneto bells on a long-distance telephone line and, at the same time, stand the

FIG 1.

severe strains and mechanical wear that is unavoidable under heavy current loads.

To accomplish this end, it was found necessary to depart from many of the old principles of mechanical construction and to design with the view of giving all the wearing parts greater strength, and to alter dimensions to procure a larger out-put of current than has heretofore been accomplished in telephone generators.

In view of the vital importance of having generator magnets that are absolutely permanent in their magnetic strength, the company, instead of purchasing its steel in the open market on the recommendation that it is "good steel," has adopted the best grade of carbo-manganese magnet steel which it has made up to its own specifications.

Each lot of magnet steel is first subjected to a chemical analysis before it is used to determine whether it is up to the standard specified. It is then formed into magnets, with a number stamped on the inside of each, to designate the particular lot of steel from which they are made. The magnets are then hardened. In this process an ingenious device is used for clamping the magnets to a gauge during the period of chilling to prevent them from springing and to ensure a perfect fit to the sides of the pole pieces. After the hardening process, they are inspected for cracks and flaws and then nickel plated, after which they are magnetized and put through the company's special process of ageing—a process similar to that used in treating instrument magnets for permanency. By this method all magnets

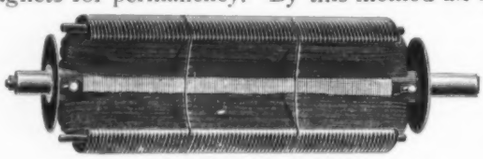


FIG. 2.

are rejected which will not stand up indefinitely without de-magnetizing.

No less attention has been paid to the mechanical details of construction. The armature, as shown in figure 2, is built up of laminated sections of de-carbonized iron and is mounted on a steel shaft which is turned to accurately fit the bronze bearings in which it runs. The armature is insulated with muslin and pure grain alcohol shellac, instead of the ordinary "insulating varnish," and has hard rubber studs inserted at the ends to hold the wire in place, leaving the winding free to be unwound in case of repairs.

In order to make the generators capable of giving exactly the same result on a bridging line the armatures are wound, by means of convolution counters, to the same number of ampere-turns, thus ensuring the same voltage and current output in all.

A valuable improvement in the Monarch generator is the placing of oil guard discs on the armature shaft, between the winding and the journal bearings in such a way that the machine may be freely oiled without danger of saturating the wire with oil and causing short circuits, and the consequent weakening of the ringing efficiency.

The bottom of the field-pieces are milled perfectly true with the concave surfaces so as to avoid springing the working parts out of true and causing them to bind and turn hard when the generator is screwed fast in the box.

A novel feature in the construction of the Monarch generator is that all the working parts are of steel, and run in bronze bearings, this principle being even carried out in the gearing, the large gear being made from bronze and the pinion of steel of such proportion of hardness that the ratio of wear is the same in both.

The company claims to have entirely overcome the annoying feature of the breakage of pinion cushion springs by adopting the arrangement shown in detail in figure 3, in which two piano steel wire springs are placed inside a steel cup in such a manner that they are engaged by the two studs in the steel pinion, and are *compressed* instead of being *stretched* when the machine is operated. It will be seen that should the springs be broken or even taken out altogether the studs would be engaged and the generator could be operated as usual. The shunt springs are made of spring phosphor bronze with platinum rivet contacts and provided with binding posts which extend out to a

FIG 3.

convenient position for making the necessary connections in the box without disturbing the other parts. With the shunt in normal position, the armature is short-circuited, making it impossible for it to be burned out by lightning or other heavy electric currents.

The Monarch generator is made in three sizes, four bar and five bar for bridging and three bar for series work.

A very interesting and, at the same time, useful method is employed by the company for keeping a complete record of the generators that are turned out of its factory. Each machine bears a serial number and is tested at a given speed for voltage and current output. A record sheet is used on which is entered the number of the generator, the date of inspection and test, voltmeter and amperemeter readings, the size of wire, resistance, and the number of turns on the armature, also the particular lot of steel from which the magnets are made, and the number of a specification that covers the design of all the detailed parts of construction.

It will be readily seen that this is of inestimable value to customers who desire to know at any time the capacity of their generators or in ordering repairs, as all parts are made to standard guages and are interchangeable.

The company points, with considerable pride, to the fact that although it has turned out over 18,000 generators in the past two years, less than a dozen have been returned as defective.

If you lived in Chicago you might be able to collect $50.00 that you had paid in excess of the law in maintaining your local telephone service.

A NEW TELEPHONE SWITCHBOARD.

The Standard Telephone & Electric Co., Madison, Wisconsin, has recently placed its new switchboard upon the market, which is shown in the accompanying illustration.

FIG. 1—SWITCHBOARD—STANDARD TELEPHONE AND ELECTRIC COMPANY.

There is no radical departure in this new board from what is considered good telephone practice, but there are included in its design a number of new features in the mechanical details which places the apparatus in the front rank of telephone construction.

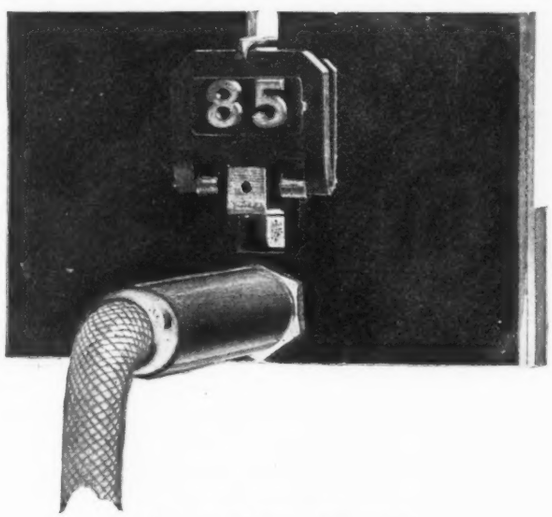


FIG. 2—DROP AND JACK.

The drops of this switchboard are of the automatic restoring type, the shutter being closed by means of an auxiliary spring, which acts when the plug is inserted to answer the call. (Figs 2 and 3.) The jack is mounted immediately below the corresponding drop, there being five drops and jacks per strip. The mounting strip is stiff, being made from cold drawn steel, one-eighth of an inch thick and faced with hard rubber upon which the shutters are mounted. The night alarm contacts have been carefully looked after in the new board, the shutters being purposely made of heavy stock so that good, positive connections can be secured when they fall.

The drops are all tubular, wound with large enough wire

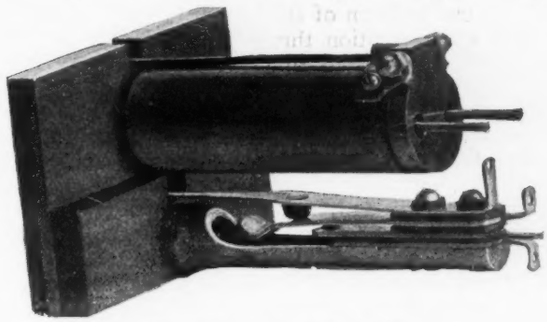


FIG. 3—DROP AND JACK.

so there is only a minimum chance of a burn-out. The tubes have been chosen of a good size, to accommodate large sized magnet spools. The drops are rigidly fastened to the mounting strip, to withstand the rough usage of railroad freight handlers, while being in transit, but may be quickly taken out by removing two screws. There is always long enough connection to the drop, so that it may be handled without disconnecting the wires. The drop and the jack are each wired back into the cable, enabling one to be removed without disturbing the other. The jack may be taken out by unscrewing the ferrule from the front of the mounted strip, and if it is desired a whole strip of drops and jacks may be taken out without disturbing even the night alarm circuit.

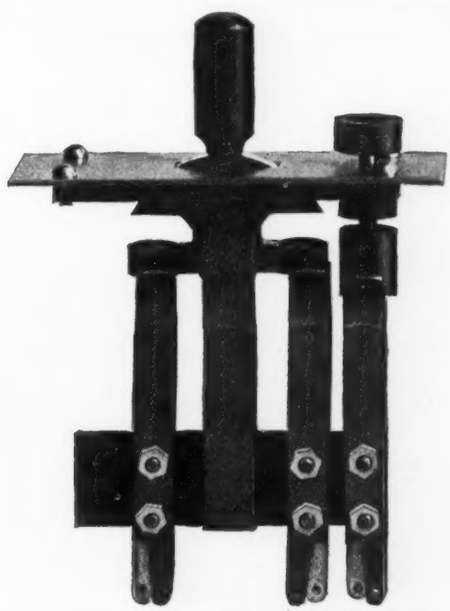


FIG. 4—RINGING AND LISTENING KEY.

The mounting strips are screwed to a steel frame which always holds them rigidly in position. Directly below the line drops and above the clearing out drops, a space is reserved the width of a mounting strip. This space may be used for transfer connections or for toll line equipment, and is therefore very convenient for that purpose.

All cords are made long, so as to allow for making connections at a good distance and also to permit cutting back

where cords wear out next to the plugs. The cords are reinforced next to the plugs, and the tinsel, which is of the finest quality, is protected throughout its entire length by a spiral wire. The plugs are strongly made, and are very easily attached to the cords.

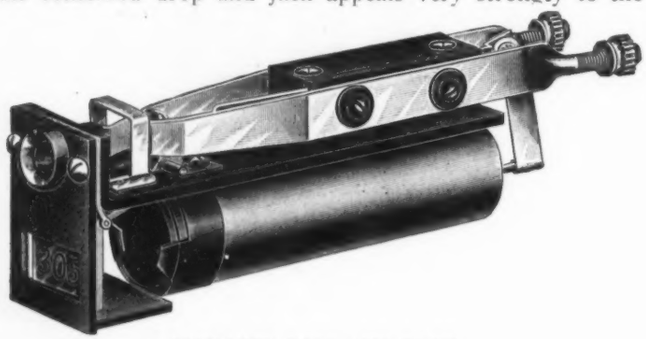
It is also claimed that the Standard Telephone & Electric Co. has one of the finest listening and ringing keys on the market. (Fig. 4.) The new key is made so that it will do the work as nearly perfectly as any key now in use. The lever moves with smoothness and without the snap, so prevalent in many other keys. There is no danger of ringing a subscriber in the ear when the operator moves the lever from listening position. The new key has a lever and a push button; one position of the lever rings on the calling cord, and the other position throws in the operator's circuit. The button is used to ring on the answering cord. All springs are of German silver, insulation of hard rubber, and the contacts genuine platinum. The key is so designed that by removing two screws it may be lifted out of the keyboard, and by removing the screws from the escutcheon, the key may be removed from the under side of the key shelf. All the springs are made interchangeable, so that in case of accident new springs may be sent from the factory, which will fit perfectly.

The cabinet is made of solid quarter-sawed oak, of golden oak finish, hand rubbed, and of a hard varnish which will not readily scratch. On the plug shelf, there is a covering of sole leather. This covering of leather prevents the noise of the plugs striking the shelf, and also prevents marring the finish of the cabinet.

A number of new "Standard" switchboards have been installed and are in operation, and from advices received from purchasers the new apparatus is all the company could desire in the way of praise for its efficiency, both mechanically and electrically.

WESTERN ELECTRIC SUPPLY CO.'S NEW SWITCHBOARD, DROP AND JACK.

The Western Electrical Supply Co. is placing a new telephone switchboard on the market, for which many claims of superiority are made. The combined jack and drop employed is claimed to be superior, not only in mechanical design, but also in electrical efficiency, by reason of the armature being mounted on the front end of the coil and the manner in which it is otherwise constructed. It is stated that extensive tests have shown that only one-fortieth of the usual expenditure of electrical energy is necessary to operate this drop. Moreover, the simple construction of this combined drop and jack appeals very strongly to the



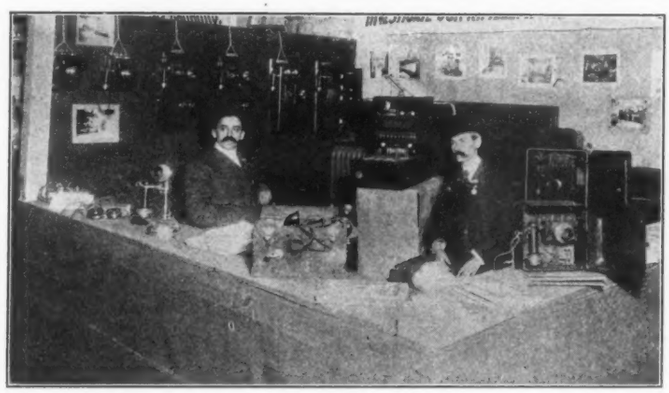
COMBINED DROP AND JACK.

practical telephone man, and combining these features with the compactness and the general high grade construction of the switchboard, the manufacturers believe that it will appeal to all telephone engineers who note currently the progress and the improvements made in telephone apparatus of every description tending to a higher state of perfection and efficiency. It will be noticed that the manner in which the armature is placed is a decided departure from other devices of this kind. The drop shutter when in the retained position rests squarely upon the armature itself, the rod that is customarily used for holding the shutter in place being discarded. Another advantage is that the armature does not operate on any hinge, but rests by its own weight on a knife edge at the bottom, which is on the principle of the most accurate weighing devices in common use. The space occupied by the complete structure comprising the combine drop and jack, is only one by one and one-half inches, which makes the switchboard very compact. Still another point is that the mechanical restoring device is absolutely positive in its operation.

STROMBERG-CARLSON EXHIBIT.

The Stromberg-Carlson Telephone Manufacturing Company's exhibit at the American Street Railway Association gathering in Detroit during the week of October 6 to 11, as shown in cut, attracted a great deal of attention on the part of railway men and other visitors to the display held at the Armory building.

Three types of telephones suitable for railway service were on exhibition. One is the style used by the Milwaukee Gas & Electric Company, while the second is a large, strong, water and air-tight box containing a complete set



STROMBERG-CARLSON EXHIBIT.

of instruments intended for use in exposed places, outdoors and underground. This 'phone is also well adapted for use in mines, lumber camps, railway yard masters' offices, etc.

A combination switchboard, illustrating the different types of apparatus, such as generator, visual signal and lamp signal line equipments, was also on exhibition, and the methods of connecting the various systems together illustrated and explained by the representatives in charge of the exhibit. Portables, pocket combination telephone sets, testing sets, and central energy and bridging telephones were on exhibition, and the telephone connected with the switchboard.

The usual energy displayed by the Stromberg-Carlson Telephone Manufacturing Company was noticeable in the manner of its exhibition, having been arranged for and placed in position with a very few hours.

THE INTERNATIONAL RESIDENCE TELEPHONES.

Among the various styles of telephones now in use, there are probably none better adapted for residence use in central energy public exchanges than the instrument shown in Figure 1, recently put on the market by the International Telephone Manufacturing Company of Chicago.

This instrument is very neatly designed and compactly constructed. The cabinet-work is of a proper proportion to receive all the parts of the company's regular public exchange central energy instrument, with ample room between the parts for inspecting and testing the instrument.

Figure 2 shows the instrument open, bringing into view

all the working parts excepting the condenser, which is placed in the base from the rear.

The gongs are mounted on top of the case, upon adjustable bell stands. The ringer is fastened in the rear of the case at the top and firmly clamped by heavy machine screws passing through the woodwork and threading into the metal part of the ringer. The ringer is provided with a thumb screw adjustment so that the yoke, carrying the armature, may be readily adjusted at one side.

The bell hammer pin is threaded and set into a thread stud so that the pin may be lengthened or shortened to correspond with the thickness of the woodwork on which

FIG. 1. INTERNATIONAL RESIDENCE TELEPHONE (CLOSED).

it is mounted. This adjustment enables arranging the ringer so that the hammer will strike the gong at the point to secure the loudest and clearest tone. The bell hammer is provided with a neat, nickel-plated brass guard to prevent foreign material falling into the instrument, as well as protecting the bell hammer.

The switch is mounted in front of the ringer upon a firm metal bracket. The bracket is fastened to the side of the case by two machine binding screws passing through the case from the outside and threading into the metal. The switch-hook casting is neatly designed and is of sufficient weight to give the hook proper strength.

The switch standard is a rigid brass base into which is clamped the contact spring insulating block. The springs are clamped into the block by a brass plate held in position by a machine screw passing through the insulating block into the metal of the standard. The springs are insulated from the binding plate by a heavy sheet of mica.

The switch restorer is a heavy German silver spring six inches in length, which passes over the rear of the standard and above the hook and is so fastened that it avoids all scraping or rubbing of parts excepting at the contact points, where it forms a sliding connection, making a clean and positive contact at all times. The springs are perfectly insulated from the standard and hook.

The induction coil is mounted in the bottom of the case. The wire fasteners and cord terminals are mounted on a special terminal block fastened on the induction coil.

The line wires lead direct into the instrument from the rear and are connected to a pair of special clips, mounted in the bottom of the case, inside.

On the outside of the case, directly underneath the switch-hook, at the proper distance, is mounted a small rubber button to avoid the marring of the woodwork by the receiver when hung on the hook.

The receiver is one of the most strong and substantially constructed instruments of its kind. It is neatly designed and has no metal parts exposed. Its magnet is of the double pole horse-shoe type made of one piece, of the best magnet steel. The magnet and magnet-spools are firmly clamped into an adjustable head so that the receiver may be adjusted and firmly held in its adjustment by a pair of set screws. The diaphragm is clamped to the metal head by a metal ring to avoid depending on the rubber cap for the adjustment of the instrument.

The receiver cord is of the best grade silk-covered conducting cord and is terminated inside of the shell upon a pair of clips which are connected with wire direct from the magnet coils. The receiver cord terminals are provided with proper clips for securely holding the cord by its braid to take all strain from the conductors as well as taking all strain from the rubber shell and cap. All parts are self-contained, leaving the shell and cap to serve only as a covering.

The transmitter is of the strictly long-distance, granular carbon type. The electrodes are highly polished hard carbon discs. The front electrode is mounted in a light cup which is secured at the center of the diaphragm by a binding nut from the front. The back electrode is mounted upon an adjusting block set into a collet secured to the transmitter bridge. The adjusting collet is insulated from the bridge by mica, the adjustment being so constructed that

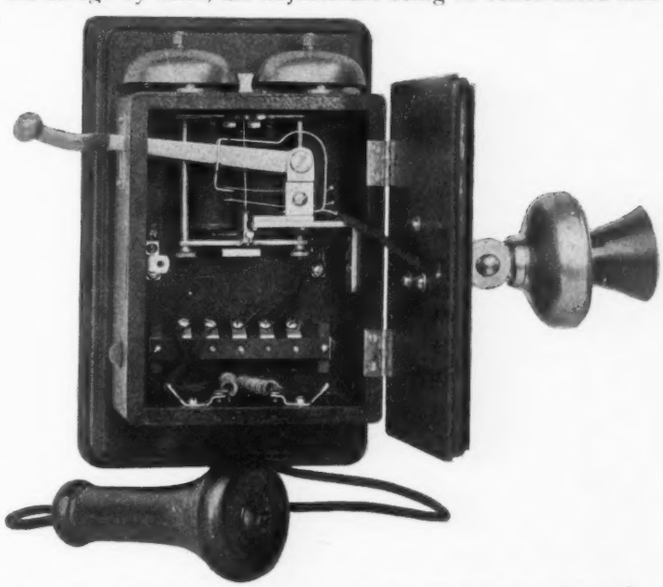


FIG. 2. INTERNATIONAL RESIDENCE TELEPHONE (OPEN).

when the transmitter is set at its most efficient point, it can be firmly clamped without changing the adjustment.

The carbon cup is closed to retain the granules without the use of felt, plush or other material subject to becoming compressed and unserviceable. A small mica ring is clamped between the back electrode and the carbon chamber.

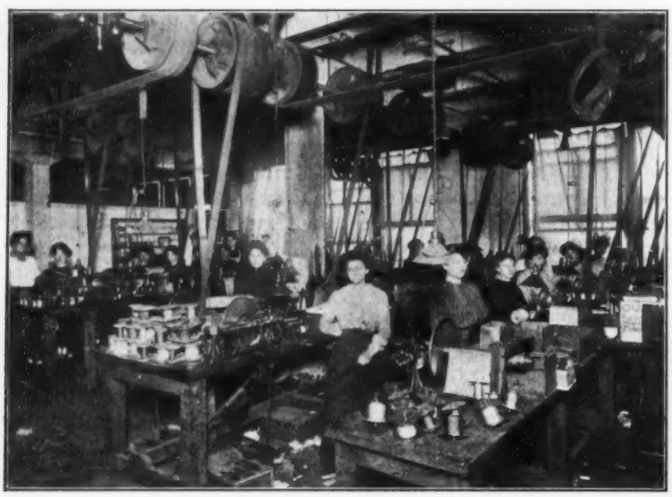
The International telephone is so constructed that there are no exposed metal parts that form a part of the circuit at any time, making the instrument especially adapted for residence use.

Pioneer Insulating Plant.

The McDermid Manufacturing Company was organized and incorporated in 1894, under the laws of the state of Illinois, with offices and factory at 207 South Canal street, Chicago. The first officers were F. W. Burlingham, president, J. M. McDermid, treasurer, and C. L. Burlingham, secretary. The first lines of the company were confined almost entirely to those supplies coming under the general designation of "house goods."

With a change in management the year following, the company has associated itself closely with the Independent telephone movement and its products are widely known through the United States.

Foreseeing the demand for magnet wires the company started, experimentally, with four machines for insulating



WINDING ROOM, M'DERMID MANUFACTURING CO.

with silk and for six months worked to perfect its goods, then two more machines were added, together with a braiding plant; from this time the increase in the plant has been rapid, until at the present time, while possibly not the largest, is probably the best equipped and finest of its kind in America.

The first to start in this line of work in the Independent field, the company turned out two or three sizes of silk wire; to-day it is supplying anything that may be desired in the line of wires and telephone cordage.

The machine department comprises the usual variety of tools found in shops that turn out a general line of telephone and experimental work.

In the old quarters on Canal street the only dressing and retiring room for the women employes was a dingy corner of the space then occupied, without windows opening to the sunlight and with no facilities for comfort. When the question of space in the Electrical Building was considered it was determined to take additional space necessary to give the girl employes a bright, sunny room suitable for a club and lunch room. Space was therefore apportioned off and provided with tables and settees sufficient to accomodate all who might desire to come there.

About a year ago some of the employes began a discussion as to the feasibility of founding a circulating library and from this suggestion, which met with instant favor at the hands of the company, grew the idea of organizing such a club as might encourage other desirable social activities.

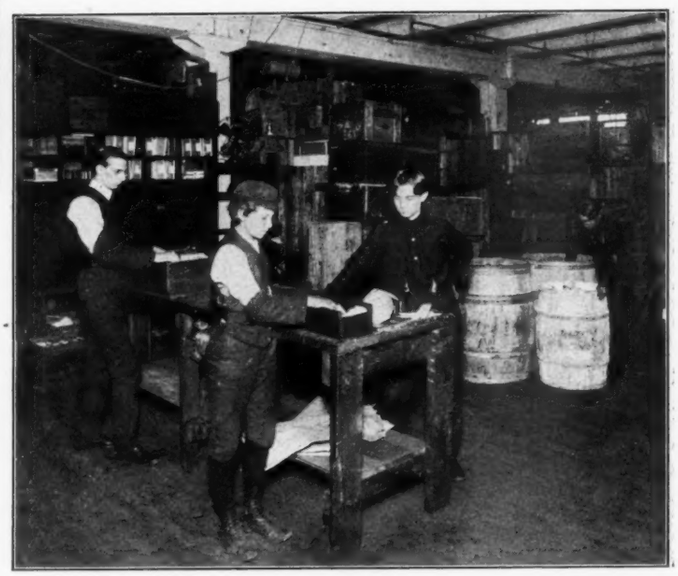
A constitution was drawn up providing for a simple form of organization, embodying the usual clauses regarding officers, their duties, committees and objects of the association, and the "Libra Club" became a full fledged organization.

The friends of the effort were not slow to respond and in the year that the club has been in existence it has a library of about one hundred volumes, mainly in the line of fiction as well as the more prominent literary publications.

In addition to the books the club has its own piano in its room and this has had the effect of bringing its members more closely together, as a number of them are good musicians.

Questions have come before the club that have aroused animated discussion, but such occasions have been met in the spirit of a fair compromise and the verdicts of the majority of the club have been accepted by the minority.

What the club has actually accomplished may seem of small amount, yet from its experience there is much to be learned of interest to manufacturers. What the company has done was done with a desire to establish between the company and its employes a relation which would be as just as possible; there has been no desire to insist that from the opportunity thus afforded for club life the employes should exhibit a gratitude that should militate against other of their interests. Fairness alone demands that employes should have reasonable light, reasonable air, reasonable space to work in, and a reasonable opportunity to meet socially during such time as they are not working. If these conditions, therefore, are met, there should be no ground



SHIPPING ROOM, M'DERMID MANUFACTURING CO.

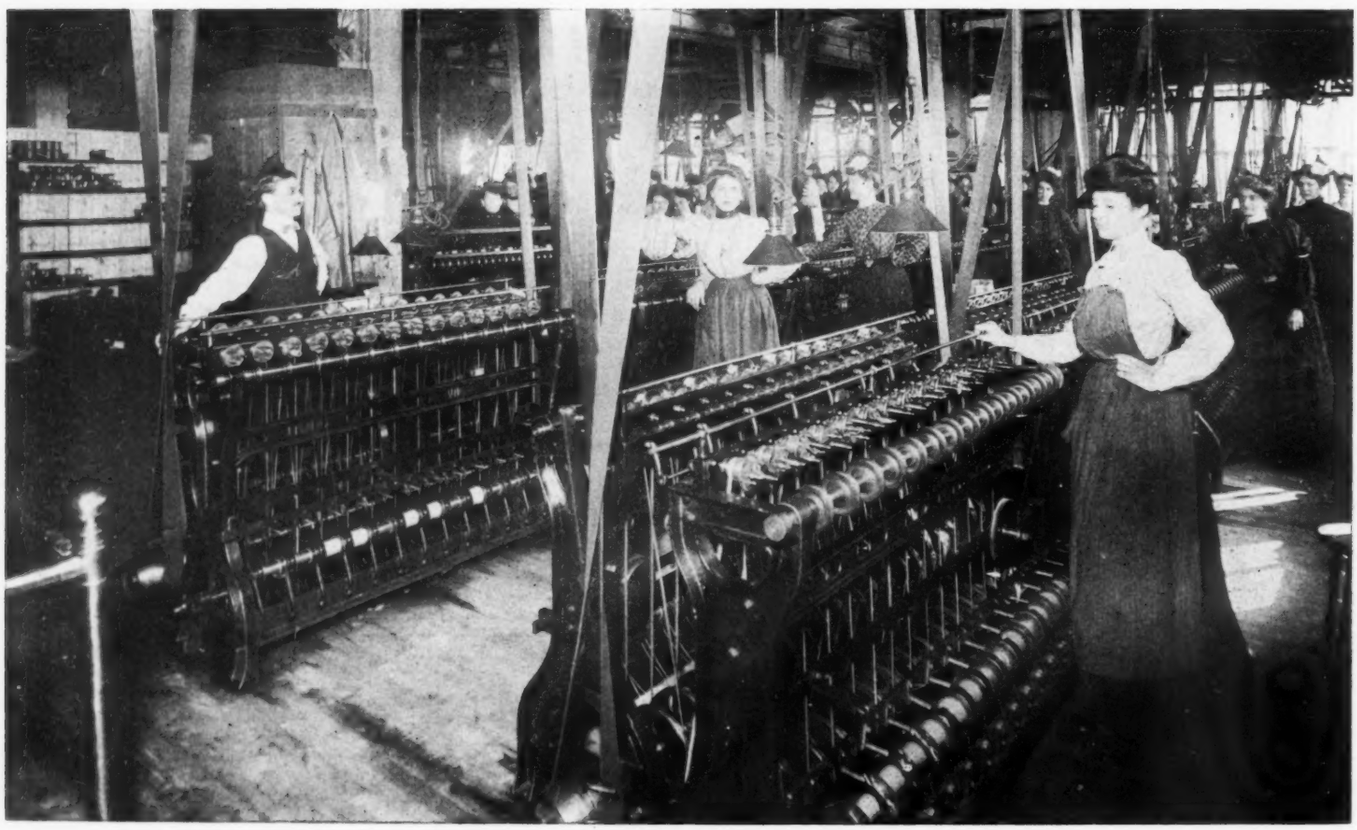
for demanding gratitude, and no ground for surprise if employes ask that other conditions be modified.

One further point is well illustrated in the history of the club, namely that its success will depend not on how well it may seem to the employer to fulfill its functions, but on how it appeals to the members of the club itself; the demand for the club life should spring up in the minds of the employes, and should be allowed to follow their democratic demand. The company in this case thought that a lunch room would be successful and a bond to bring the employes closer together; but this did not immediately appeal to the employes, who yet arrived at the desired end by another pathway, that was more successful since it was their own. For one who wishes to learn of the wisest methods for establishing satisfactory relations between employer and employe, no better reference can be given than to the chapter on Social Amelioration in Miss Jane Addams' book, Democracy and Social Ethics.

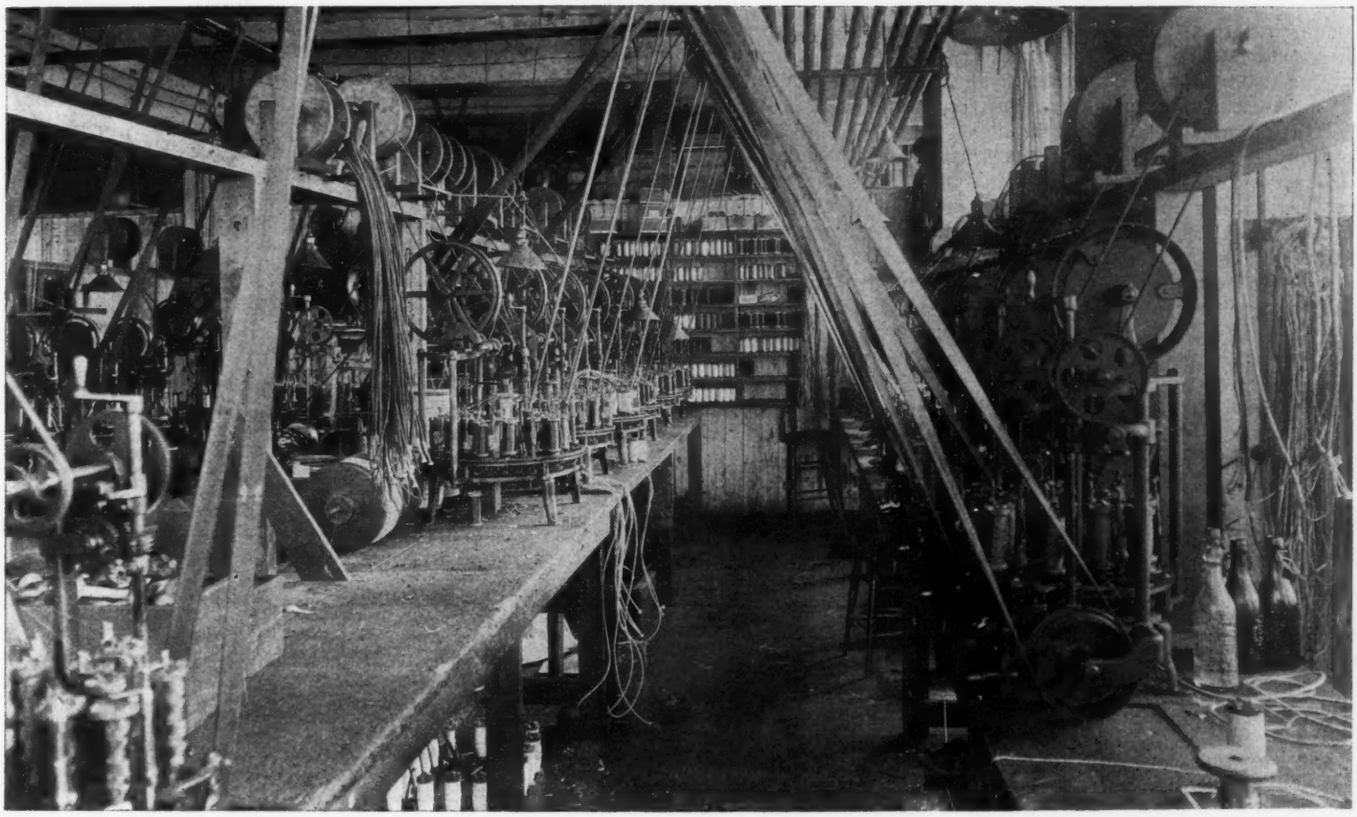
GENERAL OFFICE, M'DERMID MANUFACTURING COMPANY.

OFFICERS OF THE "LIBRA CLUB," M'DERMID MANUFACTURING COMPANY.

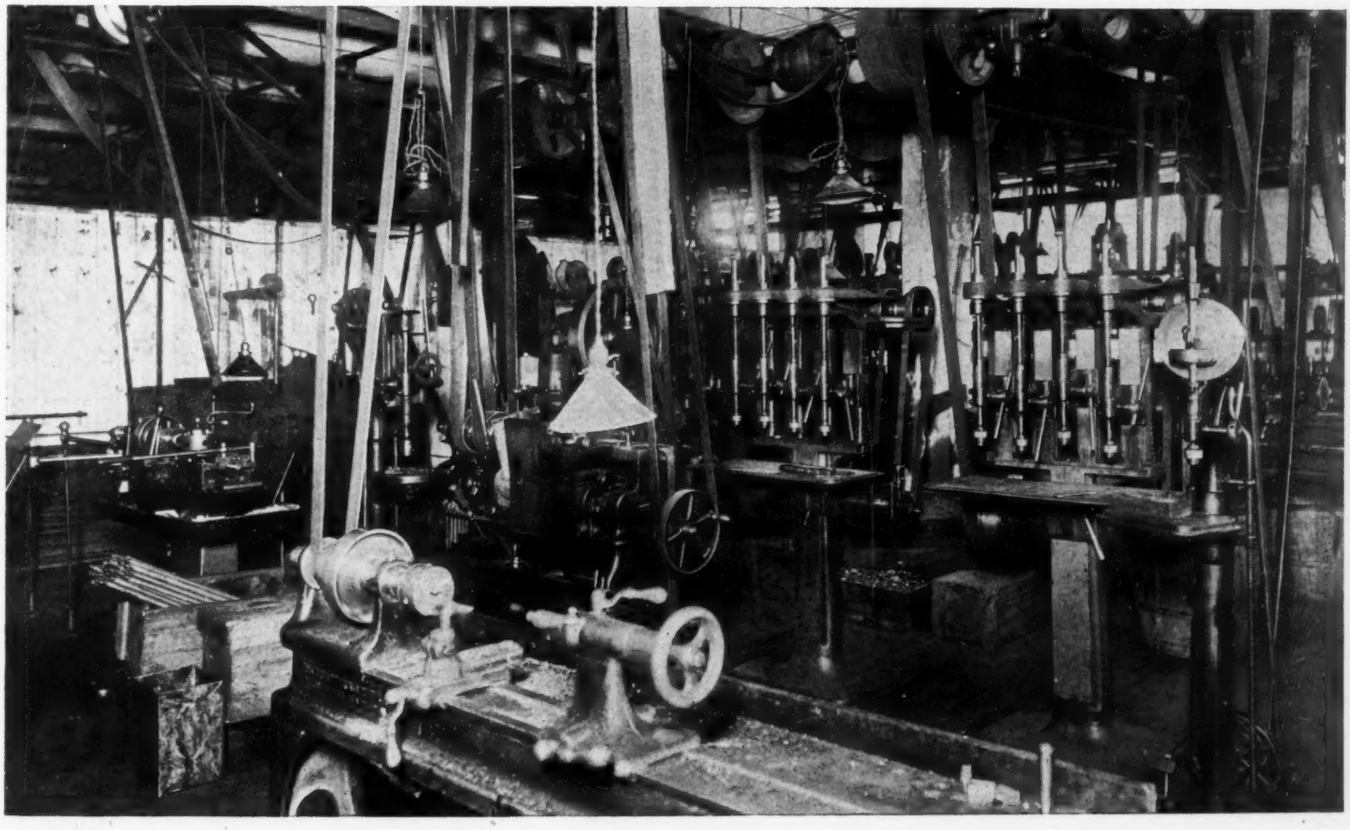
SILK AND COTTON SPOOLERS, M'DERMID MANUFACTURING COMPANY.



IN THE INSULATING DEPARTMENT, M'DERMID MANUFACTURING COMPANY.



ISLE IN BRAIDING ROOM, M'DERMID MANUFACTURING COMPANY.



A CORNER OF THE MACHINE ROOM, M'DERMID MANUFACTURING COMPANY.

FAREWELL ENTERTAINMENT.

On Saturday evening, October 11, a most enjoyable luncheon and dancing party were given at the Stromberg-Carlson Telephone Manufacturing Company's factory. The entertainment was arranged by the employes of the insulation and winding department, and tendered to the employes of other departments throughout the building. The affair was in the nature of a farewell party, and due to the fact that during the week of October 13 many of the employes of the insulation and winding department of the Chicago factory go to Rochester, N. Y., where in future the insulated wire and cable product will be manufactured at the Stromberg-Carlson Company's Rochester plant.

About a year ago a restaurant service was provided for the young women employed by the company, and since that time luncheon has been served daily in this department. It has been in part self-sustaining, and it was the surplus in the treasury which the young women proposed to use toward defraying the expenses of the entertainment. Mr. A. L. Stromberg, however, was heartily interested in the programme from the beginning, and very generously defrayed the greater part of the expense in order to make the affair more enjoyable. As a result the occasion was one which will be long remembered most pleasantly by all. It was midnight when the dancing ceased, to the strains of "Home, Sweet Home."

The seventh floor, east side, was cleared in the afternoon, and within a few hours complete preparations were made to accommodate the company. Additional electric lights were placed, tables prepared, and seats arranged for one hundred couple. Three times these tables were filled, and much credit is due the ladies who had the service in charge. Music was furnished by Bredfield's orchestra, consisting of seven pieces. Vocal solos were rendered by Mr. Hedman and Miss Frobenius. Short speeches were made by Messrs. Stromberg, Stiger, Nate, Mahon, Runzel, Hedman and others.

Mr. Stromberg's speech was particularly happy, in that it expressed the sincerity of his interest, and gratified pride at the faithfulness of his employes, and the manner in which the business has been carried to its present successful issue.

Over 400 were present, of which the following is a partial list:

Officers and representatives: A. L. Stromberg, C. W. Stiger, A. J. Rousseau, J. J. Nate, T. R. Finnucane, A. J. Mahon, W. H. Durrant, C. E. Knickerbocker, F. L. Middleton, Carl Schafer, A. A. Anderson, Joe Carlson, W. H. Gray, W. L. Roberts, C. M. Hedman, J. Peterson, Wm. Schuber, Wm. Runzel, E. W. Anderson, A. O. Stigberg, T. C. Troy, Frank Lind, J. N. Woods, W. Ratke, S. E. Wallace, J. S. Troy, C. B. Arbeen, J. P. Lillig, N. Engstrom, A. Peterson, John Meinema, Jas. Krabec, J. Kaiser, A. Hendickson, A. B. Blidd.

Employes: Messrs. Backstrom, John Johnson, Ryan, Kuepper, Thorsell, Schneberg, J. W. Johnson, Griffith, Lillig, Briggs, Knudsen, Reinke, Marriner, Bowles, Engstrom, Carruthers, Larson, Carney, C. Anderson, Dolan, A. Johnson, L. St. Pierre, L. B. St. Pierre, Willet, Donnelly, Green, Gram, Parker, Shroder, Newberg, Kviteck, Shotts, Rudland, Rickter, Smith, Peter Johnson, Miles, Ben Anderson, Larson, Robt. Larson, Cederleaf, Lindell, Erickson, Walin, Jas. Bowles, Reinhard Johnson, Wirlin, Victor Carlson, Telefson, Chas. Carlson, Abbe, Ed. Johnson, Samlow, C. F. Johnson, Glendenning, Leopold, Denny, Lundine, N. Anderson, Olson, Theo. Anderson, Gustafson, Bain, Alec. Bain, Borowinski, Wolf, J. Carlson, A. Anderson, Paul Hirch, Richter, Stull, J. Carlson, M. J. Thomas and M. Devito.

Mrs. Senn, Mrs. Casle, Misses Durrant, Hanson, Laiger, Sullivan, Murray, Akyroid, Hendrickson, Straka, Cunnalley, Winner, Kirk, Shillo, Soucke, Swanson, Troy, Logan, Amstead, Faudrop, Lottie Peterson, Dureer, Taylor, Alice Nelson, Nagorsen, Neitz, Armer, Becker, Mae Anderson, Spiak, McKinney, Lizzie Fister, Kittie Murphy, Lizzie Daker, Radora, Mame Fister, Rena Nelson, Voight, Roberts, Brode, Fay, Dwyer, Almsted, Anna Anderson, Dillon, Patra Peterson, Epstein, O'Neill, Minnie Roberts, Desparroes, George, Rose Anderson, Mae Peterson, Rena Nelson, Klinger, Murray, Webb, Gioss, Rapke, Straube, Smithson, Kallal, Hansen, Buntrock, Coates, Behnke, Bieljewske, Kober, Kent, Madog, Eilers, Fraedrick, Hattie Praedrick, Kallal, Powers, Shwekann, Inwood, Florence Nelson, McKeon, Meyer, Hanna Anderson, Beason, Casle, Bennecke, Teal, and Pettee.

HOFFMANN DOUBLE GRIP CABLE HANGER.

The accompanying illustration conveys an intelligible idea of the Hoffmann Double Grip Cable Hanger, manufactured by the Greer Electric Company, 60-66 West Van Buren St., Chicago. This hanger has only been on the market a short time, but owing to the fact claimed, that it is a radical improvement over the old style hanger, has caused

HOFFMAN DOUBLE GRIP CABLE HANGER.

its adoption by several of the largest telephone companies in the country. It is a two-piece hanger, the hook being made of galvanized steel wire and the strap of zinc. It is adjustable to any sized cable and is absolutely rigid and immovable when once fastened. The company invites correspondence and is prepared to quote very attractive prices to those interested.

TELEPHONY is a fine paper and I would not be without it.—M. M. Pyle, Ada, I. T.

Admire your publication as the finest in the telephone field.—Roscoe Hunijones, Oakland, Cal.

The Equipment of a Modern Telephone Exchange.*

Telephone exchanges have already formed the subject of several interesting papers which have been read before our society in London, but as telephony, like all other branches of electrical science, is progressive, I trust that this paper of mine will not be a case of "bringing coals to Newcastle."

The three systems I have selected for description may be taken as representative of the most recently built ex-

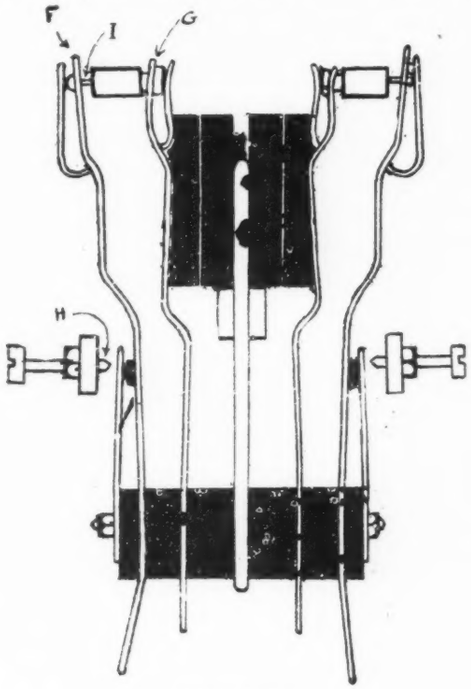


DIAGRAM 1.

changes of this country. I will avoid, as far as possible, an expression of preference for either, but will describe the merits of each and will give the number of movements an operator has to make in each case to effect a connection or a disconnection. This must not, however, be taken as a sole test of merit, for although the question of operating is one of the most important the telephone engineer has to consider when designing a switchboard, he must also take into consideration simplicity of apparatus, for, other things being equal, the simpler the switchboard and attendant apparatus the better. If complicated apparatus is to be introduced in order to reduce the work of the operator or to give additional facilities to the subscriber, the amount of the reduction of work or the value of the additional facilities, must be weighed against the increased liability to faults through any complication of the apparatus. As the majority of the apparatus used in a telephone exchange is well known to most of you, I have not attempted to explain it in detail, but I have samples here for your inspection and will be pleased to give a description of any particular part, should any one desire it.

The first of the three exchanges I have selected is fitted with series jacks and hand-restored indicators. The line connecting the subscriber's office with the exchanges is led into the testroom and connected to a device for protecting the exchange apparatus from lightning or heavy power currents, which may, through an accident, find their way over the subscriber's line. This device is designed to protect both lines, but a description of one side is all that will be needed. The lightning protector (Diagram 1) consists of two blocks of carbon, separated from each other by a thin sheet of mica, in one of which a small hole has been drilled and filled with fusible alloy. These are held in position and against the frame plate by springs, G.

For protection against the power current a small coil of German silver wire is wound round a thin tube filled with fusible alloy, into which is inserted a pin with a somewhat enlarged head. This coil fits into slots provided in the springs G and F, the spring G, to which the outside wire is connected, holding the base of the coil, which is insulated from the frame, but in connection with one end of the German silver wire, the other end of which is connected to frame of bobbin, and the pin shown on the diagram as I is held under tension by the spring F, to which the line leading to the exchange is connected. Should the outside line be struck by lightning a discharge will take place between the two carbon blocks, which will soften the fusible alloy and put the line direct to earth by short-circuiting the two carbon blocks. Should a contact occur between the line wire and, say, the trolley wire of the tramways, the current will find a path through the German silver wire on coil and heat the cup in which the pin is held, soften the fusible alloy and the tension on spring F will cause the pin to be withdrawn, thus breaking the circuit between the inside and outside lines. At the same time the releasing of the spring F will close a circuit through the contact at H, and indicates to the inspector in charge that trouble has occurred on that particular section of the protection board. The bobbin and the fusible alloy are so adjusted as to allow a cur-

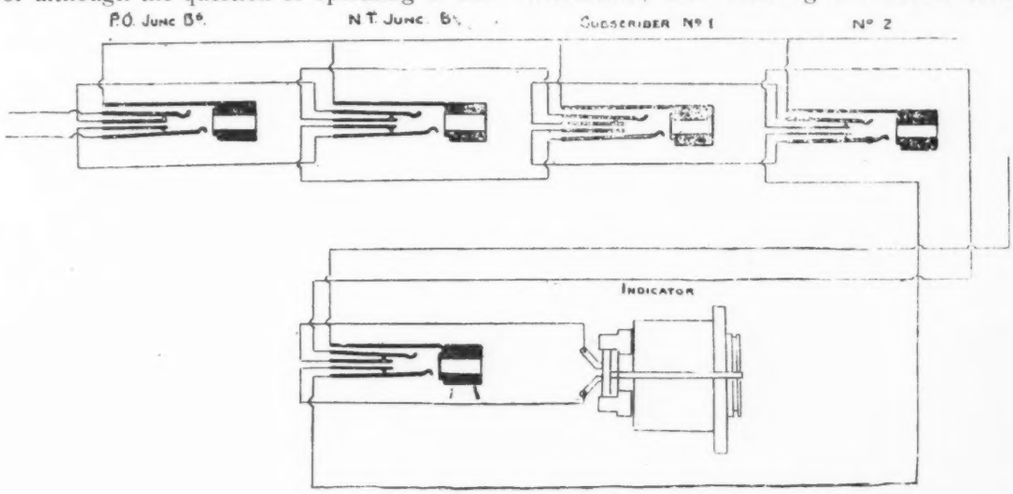


DIAGRAM 2.

rent of one-half ampere to pass without operating the device.

From the protecting device the lines are carried by means of separate leads to the test jacks, which consist of

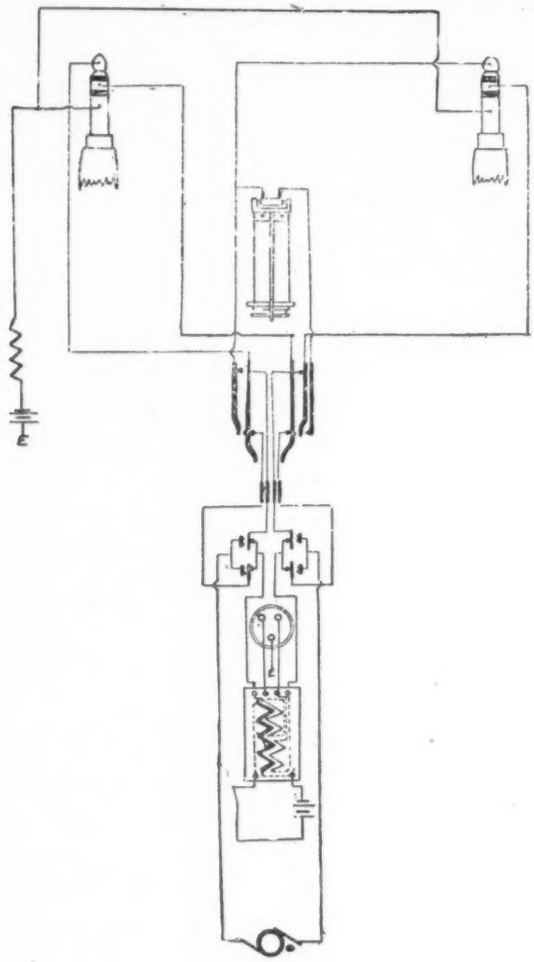


DIAGRAM 3.

rows of springs arranged in groups of four, each four forming one subscriber's test point, the line wires being connected to the two top springs and the exchange cables to the lower. This will enable the inspector, by means of a suitable plug and test set, to ascertain the condition of either of the four wires separately. Covering the aperture in front of each set of test springs is a small metal flap, which automatically opens or closes on the insertion or withdrawal of the test plug, thus protecting the contacts from the dust, which in earlier patterns of test jacks was a source of considerable trouble. From the test jacks the lines are led to the line springs on the switchboard proper (Diagram 2), first to the postoffice junction section, thence in series through the National junction board to the subscribers' sections, and, lastly, to the home section jack, or jack in front of the operator, whose duty it is to attend to that particular subscriber's wants, thence to the indicator, the latter consisting of an electro-magnet, wound to a resistance of 100 ohms, controlling the shutter or indicating disc. On the face of each jack is a metal ring, connected to each similar ring on every other jack of the same subscriber's number in the exchange, the circuit being totally separated from the speaking circuit. This is for the purpose of enabling any operator in the room to ascertain whether the line is in use on any other part of the switchboard. The operator's set and connecting-cord circuits (Diagram 3) are equally simple, three-point plugs and three-conductor cords are used in conjunction with a listening key for each pair of cords, and a double ringing key common to the pairs of cords forming an operator's position.

The speaking circuit, when the listening key is in the through position, is as follows: The tips and rings of the two plugs are joined together through the listening key, and an indicator wound to a resistance of about 1,000 ohms and sheathed with iron, so as to give it high impedance, is bridged across the circuit. The body of the plug, which makes contact with the ring in front of each jack, does not come through the listening key, but is connected to a wire common to the whole exchange, which, in turn, is connected to a battery and earth through a resistance coil. It will be noticed from the diagram that this circuit is entirely independent from the speaking circuit, and necessarily so, otherwise the earth would cause a noise to appear in the speaking circuit.

In the operator's instrument set the only apparatus that needs any description is the differentially wound induction coil and receiver. These are necessary so as to enable the operator to go into circuit of two subscribers talking without upsetting the balance of the lines, which the earth on her instrument would otherwise do, and to enable her to

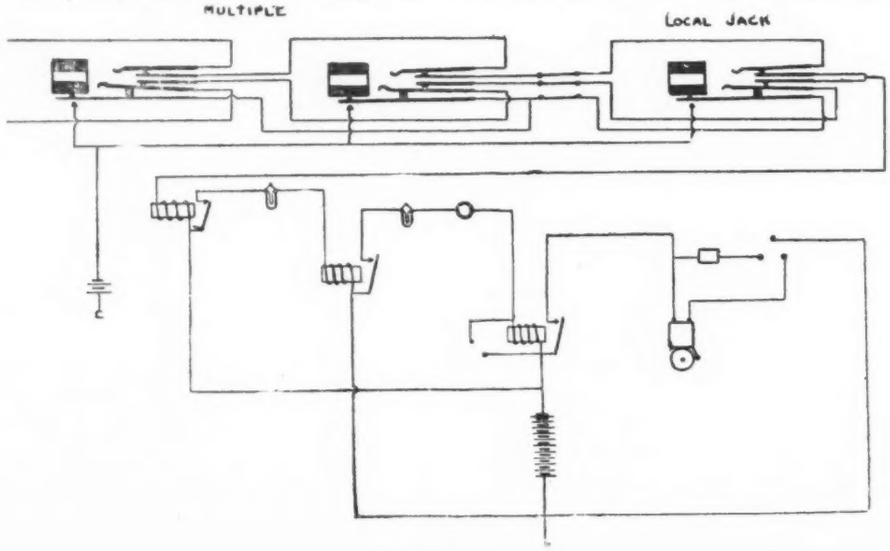


DIAGRAM 4.

ascertain whether the line wanted is engaged at any other section of the board. When the listening key is down the

operator's instrument is bridged across the cords and the indicator is cut out. The circuit is then from the tips of the plugs to the contact of the listening key, through the ringing key, to the outer end of one-half of the induction coil, through the receiver to the inner end of the second half of the coil, thence back to the rings of the plugs. The test signal is given to the operator by a noise in her receiver, caused by the earth current put on to the ring of the jack by the body of the engaging plug passing from the tip of the testing plug, through the listening key, through the ringing key, through one-half of the differentially wound induction coil, through one-half of the receiver, to earth.

The number of movements an operator has to make on this system to effect connection is five, as follows: (1) insert plug and answer; (2) insert corresponding plug into number wanted; (3) ring wanted subscriber; (4) restore listening key; (5) restore indicator; and for disconnection, four: (1) pull down key; (2) challenge line; (3) pull out plugs; (4) replace ring-off indicator.

With the relay calling and clearing system the lines, after passing through the test-room, are brought to the jacks in the exchange in a manner similar to that described in the series system, the only difference being that the two inner contacts of the home section jack are joined together and connected to a 250-ohm relay to battery and earth. The test circuit shown on Diagram 4 is also somewhat different, the line being engaged by means of an extra spring and contact provided on the jack instead of by the body of the plug and the third conductor of the cord. I might mention that the system of engaging the line is not an essential part of the relay calling system. I have selected to describe this method as an alternative to the method given on the series system. You will notice that on the insertion of the plug the line springs are lifted from the inner contacts, thus cutting off the relay and battery, and the test spring is also lifted from contact with the test ring and pushed outward and forced in contact with a stud, connected to which is an earth battery. The test springs of each jack of the same number in the exchange being joined together and in their normal position in contact with the test rings, the current of the earth battery will be on the test ring of each jack in the exchange, corresponding with the number of the engaged line, except the test ring of the jack into which the plug is inserted. The armature of the 250-ohm calling relay is connected to one side of the battery, and a contact to which the calling lamp is brought is provided in such a position that on the relay being energized the armature will close the circuit through the calling lamp, and for each operator's position a second relay of very low resistance—about two ohms—is provided, connected in the return wire common to the bank of calling lamps forming that position. The armature of this relay is connected to the positive side of the battery, and the contact joined to the pilot and supervisory lamp on the chief operators' table in series, this relay, being in series with all the line relays for the operator's position, will respond simultaneously with any one of them. From the supervisory lamp the circuit is carried through the night bell switch to the negative pole of the battery; or if the night bell switch is turned to the night position, through another two-ohm relay, the contact on the night bell relay being through bell to battery. The night bell relay is, as its name denotes, for the purpose of giving an audible signal, in addition to the visual signal, after the busy hours of the day.

The operator's connecting cord circuit is shown in detail in Diagram 5. The two tips and two bodies of the plugs are joined together, and connections are taken through the listening key, through the ringing key and differentially wound secondary of the induction coil to the receiver, the center point of which is to earth, through a 2,000-ohm simple resistance; the object of this resistance being to reduce the amount of current passing through the receiver, and consequently the click, which might otherwise be detrimental to the operator's hearing. It will be noticed from the diagrams that the operator's receiver in this, as in the series system, is in the middle of the secondary of the induction coil. With the listening key in the through position the instrument is cut out, and the line is bridged by a differentially wound retardation coil, the center point of which is

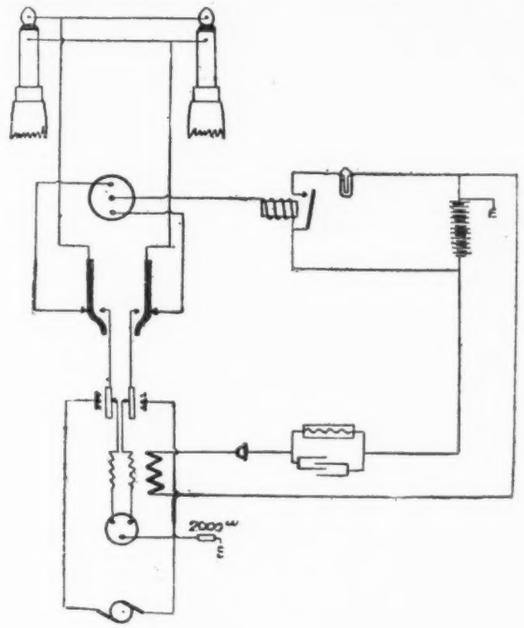


DIAGRAM 5.

connected to a 250-ohm relay, thence to negative pole of the earthed battery. The armature of the clearing relay is also connected to the same pole, and the relay contact to the clearing lamp and earthed side of the battery. The microphone circuit is also interesting, for, as it works off the common battery of 24 volts, it requires to be specially dealt with to protect the microphone from the excessive current, and for this purpose a 160-ohm retardation coil is placed in circuit shunted by a condenser of two microfarads' capacity.

The subscribers' instruments, although not properly within the scope of this paper, require a little description, for, in addition to the magneto ringer necessary in the series system, a special calling-key relay has to be provided (this relay is shown in Diagram 6). One end of the relay coil is connected to the subscriber's line wire and the other end to the frame of the relay; a special stud with adjustable contact is connected to the earth and so placed that on the

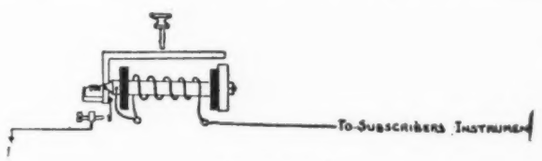


DIAGRAM 6.

armature being depressed by means of the call button the subscriber's line is earthed through the coil of the relay.

The operation of the system is as follows: A subscriber desiring to initiate a call, presses the call button, thus earthing his line as previously described. This draws a current from the central battery through his line relay, over both lines, through the call-key relay. Both relays being thus energized, the calling relay is held down, the line signal relay being also in operation, causes the lamp in the exchange to light, signifying that the subscriber requires attention, the lamp remaining alight until the current

is removed by the insertion of the operator's plug. The cutting off of the current at the exchange releases the armature of the line signal relay and extinguishes the lamp. It also allows the calling key relay to return to its normal position, thus signifying to the caller that the operator is on the line. After the number has been taken and the connection made the listening key is put up and the clearing relay is then in circuit. On completion of the conversation either subscriber can give the clearing signal by pressing his calling key, which earths the line and draws current from the central battery through the clearing relay, through the differentially wound retardation coil to lines, and calling key relay to earth, thus bringing both the clearing relay and calling key relay into operation, lights the clearing lamp at the exchange. This remains alight until the operator pulls down her key, cutting off the central battery, extinguishing the lamp and causing the button of the subscriber's calling key to return to normal, thus giving him a visual indication that his line has been cleared. With this system it is possible for any two subscribers to convert their exchange line into a private line—that is to say, after obtaining communication with the desired number they can ring one another by means of their magneto-generators without actuating the clearing lamp at the exchange, but either of them can obtain the attention of the exchange by pressing their call button.

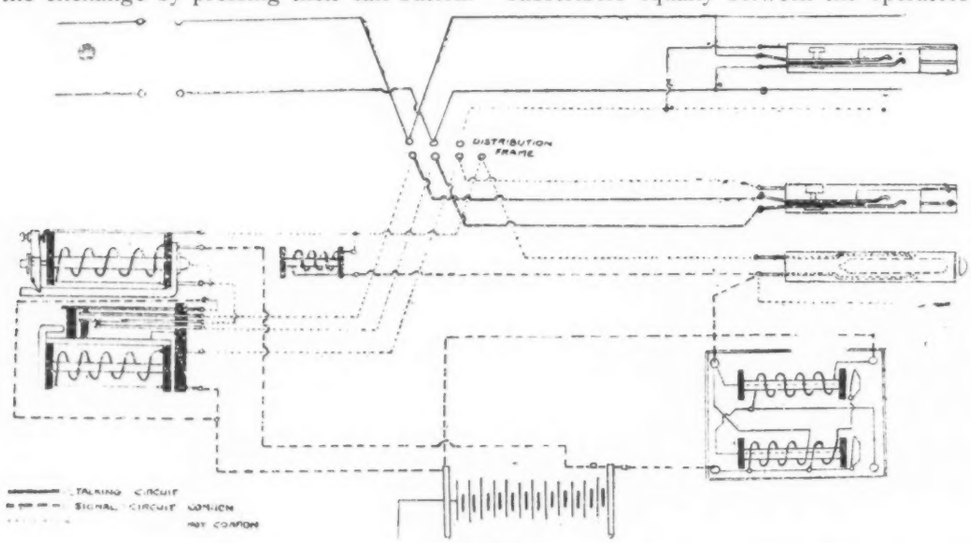


DIAGRAM 7.

The number of movements necessary on the part of the operator to effect connection by this system is four—viz., (1) insert plug and answer; (2) insert corresponding plug in number wanted; (3) press button to ring subscriber; (4) put up listening key; and for a disconnection, two: (1) pull down listening key, thus putting out the lamp; (2) pull out cords. The current necessary for working this system is obtained from a battery of 11-cell accumulator, charged by preference by a motor-generator working off the town mains. It is necessary, of course, to duplicate both the battery and the motor-generators so as to avoid the possibility of a failure of current due to breakdown of the generators or accident to the batteries.

The third system (Diagram 7) is what is generally known as the Western Electric common battery relay switchboard, in which system both the signaling and speaking current is supplied from the central source of energy, thus removing from the distant station one of the most fruitful sources of trouble—viz., the battery for working the transmitter. The lines, after passing through the test-room, are brought to a distribution frame. This consists of a series of double tabs, arranged in groups of three in blocks of 60 on the one side and in groups of four double tabs in blocks of 80 on the other. These blocks are supported on an iron frame, one side in horizontal rows and the others vertically. The two sets of tabs are held about 3 feet 6 inches apart, and insulated rings are provided midway between them. The lines from the test jacks are brought to the horizontal side of the frame and cables from the multiple of the switchboard are brought to the same set of tabs and soldered to one side, the cable from the switchboard containing 63 wires laid up in threes, the odd wire being that in connection with the test circuit. From the four-way double tabs on the vertical side cables are led to the home section jacks and calling lamps, and also the relays controlling same, four wires for each subscriber's circuit being taken to the switchboard—viz., two to the line springs of the home section jack, one to the test circuit and a fourth to the calling lamp. Four wires are also carried to the relay frame, two from the line tabs to the cut-out springs of the cut-off relay, one from the test tab to the winding of the cut-off relay and the fourth to the calling lamp contact on the line relay. It will thus be seen that the lines on the horizontal side of the distribution frame are arranged in numerical order or similar to that of the multiple of the switchboard, and on the vertical side in order of the home section jacks and calling lamps. The object of this distribution frame is to enable the work of each operator's position to be equalized by distributing the very busy subscribers equally between the operators' positions. This is done without disturbing the numerical arrangement of the subscribers over the multiple. The fact of the subscribers not being in numerical order on their calling lamps is not important, as the calling lamp of each subscriber is placed adjacent to his home section jack, and all connections with the numbers wanted are made on the multiple.

The second use of the frame is to provide a convenient point at which the wires between the home section lamps and the relays and the lines from the test-board and the multiple can be joined. The distribution of the lines over the operators' positions is made by three-conductor cable, each wire being separately insulated and the whole covered with an asbestos braiding. The three wires are colored green, pink and purple respectively, the green and pink being soldered to the line tabs and the purple to the test tabs on the horizontal side of the frame. They are then passed through the insulating rings corresponding with the operator's position on which the subscriber's calling lamp is situated and soldered on to the first three tabs, which are connected to the two lines and test of the home section jack.

(To be continued.)

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*Paper read by F. A. S. Wormull at the Institution of Electrical Engineers, Newcastle, England.